US Army Corps
Of Engineers
St. Paul District

MISSISSIPPI RIVER 9-FOOT CHANNEL PROJECT

CHANNEL MANAGEMENT PROGRAM

DEFINITE PROJECT REPORT/ ENVIRONMENTAL ASSESSMENT

POOL 3/UPPER POOL 4

CHANNEL MANAGEMENT STUDY

Pool 3 and Upper Pool 4
Upper Mississippi River
Pierce County, Wisconsin and
Washington, Dakota, and Goodhue Counties, Minnesota

June 2001

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14. ABSTRACT
The purpose of this study was to evaluate channel management in pool 3 and upper pool 4 on the Mississippi River. The study area is from the head of Lake Pepin upstream to Lock and Dam 2 at Hastings, MN. A lateral current problem below Lock and Dam 2 might be solved by extending the lower guard wall, but this would need further study. Shoaling problems were identified in the Big River reach, and shoaling and associated channel maintenance requirements are needed at river miles 799-803. Restoration of 4 wing dams at river mile 805 is recommended to reduce shoaling. Fish habitat benefits will be achieved through notching 18 wing dams and partial removal of another. The notches are designed to promote the formation of scour holes and channels to improve bathymetric diversity. Construction of a new spot dike at Carter Slough (river mile 807.3) is recommended to prevent habitat degradation occurring as a result of a bypass of the existing spot dike, and to assure the long term integrity of pool 3.

15. SUBJECT TERMS
Mississippi River Channels(Waterways) Habitat Wing dams

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POOL 3/UPPER POOL 4 CHANNEL MANAGEMENT STUDY

EXECUTIVE SUMMARY

The Pool 3/Upper Pool 4 Channel Management Study is part of the St. Paul District Corps of Engineers' overall channel management program for the 9-Foot Navigation Channel Project on the Upper Mississippi River. An important facet of the program is the use of channel control structures to reduce or control dredging requirements, to provide a safer navigation channel, and to reduce or eliminate adverse effects on river resources. The study area for the Pool 3/Upper Pool 4 Channel Management Study was from the head of Lake Pepin (river mile 784) upstream to Lock and Dam 2 at river mile 815.3

Channel maintenance, navigation, fish and wildlife, and recreation problems were identified for the study area and planning goals and objectives were formulated. The primary channel maintenance problem in the study area is the high frequency, high quantity dredging requirements in the lower reaches of the pool (river miles 799 to 803). No significant navigation problems were identified aside from channel shoaling.

Site specific fish and wildlife habitat concerns were identified for the study reach. In some locations specific causes for problems could be identified, while in other situations the concerns were associated with long term changes occurring on a river reach and/or system-wide basis.

No specific recreation problems related to channel control structures were identified, though it was recognized that maintaining existing beaches along the navigation channel was important to meeting recreational needs in the study area.

Site specific channel maintenance/navigation problems studied were a lateral current problem below Lock and Dam 2, a shoaling problem in the Big River reach (river mile 805), and the shoaling and associated channel maintenance requirements at river miles 799-803. Additional study is recommended of a potential solution to the lateral current problem below Lock and Dam 2. Construction of a 600-foot extension of the lower guard wall in the form of a rock dike was identified as a potential engineering solution to the problem. Additional investigations beyond the scope of this study would be required before this solution could be implemented.

Restoration of 4 wing dams on the left side of the navigation channel at river mile 805 is recommended to reduce shoaling in this area. The purpose is to make a bend in the navigation channel in this area more navigable and to reduce the potential for future dredging requirements.

A series of side channel modification options were evaluated for the river mile 799-803 reach. The primary focus was on retaining additional flow in the main channel to improve local

sediment transport condition. No cost-effective solution could be found.

Site specific fish and wildlife habitat evaluations included island construction below Lock and Dam 2, introducing flow to Conley Lake, repair of a bypassed spot dike at Carter Slough, island restoration in North and Sturgeon Lakes, restoration of a side channel at Diamond Island, and notching and/or removal of wing dams for fish habitat purposes.

Island construction below Lock and Dam 2 appears to have some merit in terms of providing habitat benefits. However, implementation would require a non-Federal sponsor to cost share in construction. No non-Federal sponsor was identified with an interest in pursuing this feature.

Introducing flow to Conley Lake may also have merit, though it could be a costly endeavor. Implementation would require a non-Federal sponsor to cost share in construction.

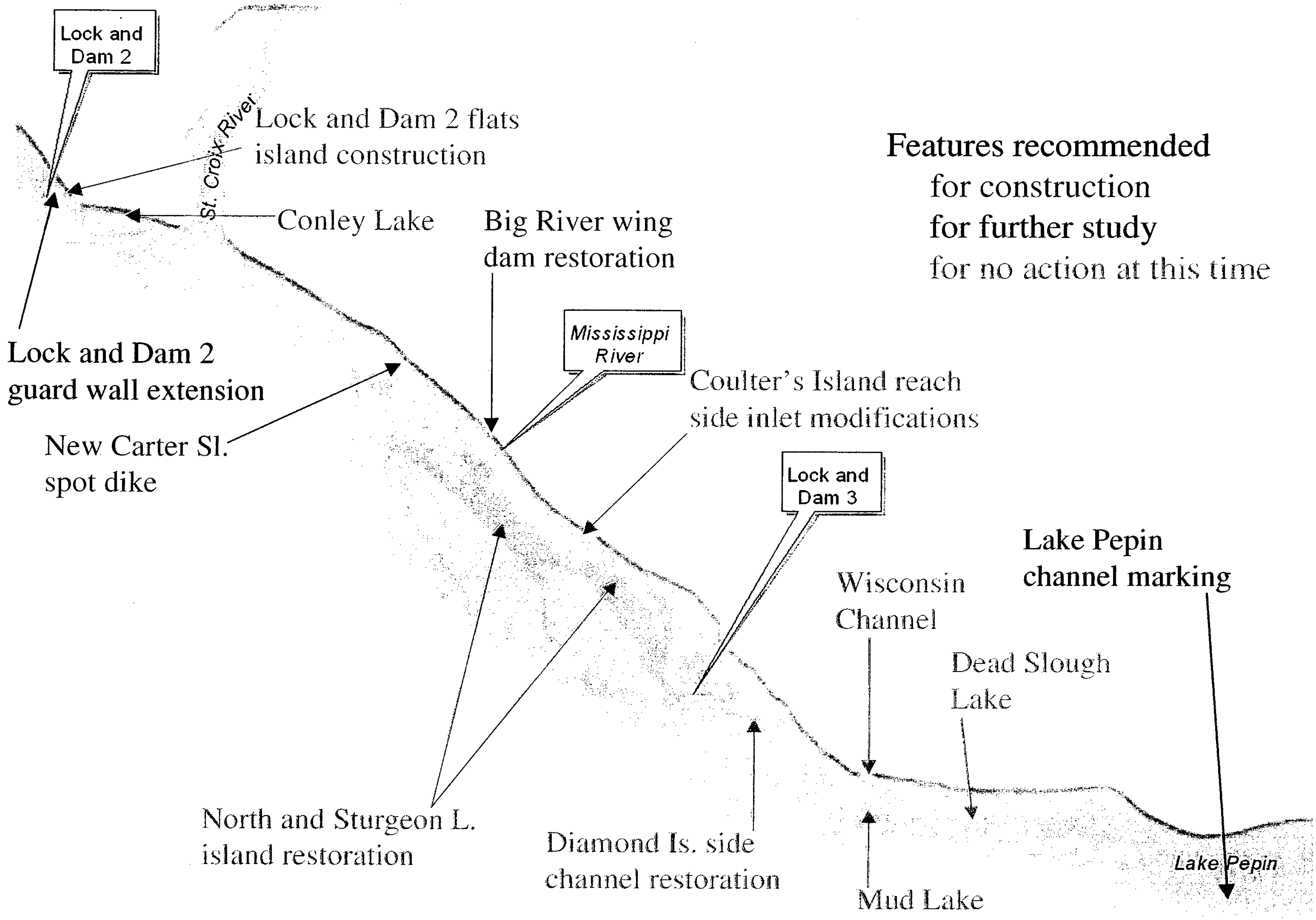
Construction of a new spot dike at Carter Slough (river mile 807.3) is recommended to prevent habitat degradation occurring as a result of a bypassing of the existing spot dike. This feature would have ancillary navigation project benefits by contributing to the long-term integrity of pool 3.

Pursuing island restoration in North and Sturgeon Lakes is considered premature at this time, pending development of a pool-wide habitat restoration plan by the Fish and Wildlife Work Group of the River Resources Forum.

A design was developed to restore the side channel behind Diamond Island. However, this feature would also require a non-Federal sponsor to cost share in construction. No non-Federal sponsor was identified with an interest in pursuing this feature.

Notching 18 wing dams is recommended to provide fish habitat improvements. The notches are designed to promote the formation of scour holes and channels to improve bathymetric diversity in relatively monotypic main channel border areas. Removal of a section of another wing dam is recommended as a test of the effectiveness of wing dam removal on fish habitat quality.

Sediment resuspension and associated water quality degradation was identified as a concern with commercial tow traffic in Lake Pepin, especially at the shallow head of the lake. It is recommended that the Navigation Work Group of the River Resources Forum investigate the potential for defining a navigation channel throughout Lake Pepin.


Features recommended
for construction
for further study
for no action at this time
Lock and Dam 2
St. Croix River
Lock and Dam 2 flats island construction
Conley Lake
Lock and Dam 2 guard wall extension
New Carter Sl. spot dike
Big River wing dam restoration
Mississippi River
Coulter's Island reach side inlet modifications
Lock and Dam 3
North and Sturgeon L. island restoration
Diamond Is. side channel restoration
Wisconsin Channel
Dead Slough Lake
Mud Lake
Lake Pepin channel marking
Lake Pepin

DEFINITE PROJECT REPORT/ENVIRONMENTAL ASSESSMENT

POOL 3/UPPER POOL 4 CHANNEL MANAGEMENT PLAN

UPPER MISSISSIPPI RIVER
PIERCE CO., WISCONSIN AND
DAKOTA AND GOODHUE CO., MINNESOTA

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DEFINITE PROJECT REPORT/ENVIRONMENTAL ASSESSMENT
POOL 3/UPPER POOL 4 CHANNEL MANAGEMENT STUDY

UPPER MISSISSIPPI RIVER
PIERCE CO., WISCONSIN AND
DAKOTA AND GOODHUE CO., MINNESOTA

INTRODUCTION

1.1 AUTHORITY

The Corps of Engineers is responsible for maintaining a navigable channel on the Mississippi River. Authority for continued operation and maintenance of the Mississippi River Nine-Foot Channel project is provided in the River and Harbor Acts of 1930 and 1932. Original authority for the Corps of Engineers to work on the Mississippi River was provided in the River and Harbor Act of 1878.

1.2 PURPOSE

One of many facets of the St. Paul District's approach to channel maintenance is to use channel control structures to reduce or control dredging requirements to reduce costs and the environmental effects associated with dredging. Other purposes are to provide a safer navigation channel, to use the river's energy for moving sediment to more strategic placement site locations, to reduce shoreline or dredged material placement site erosion that is affecting channel maintenance, and to correct channel maintenance situations that are causing adverse effects to other uses of the river. An important component of channel management is the identification and implementation of measures to reduce the adverse environmental effects of channel control structures and restore natural river processes and functions as much as possible. A related purpose of this program is to increase knowledge of sediment transport characteristics for applications to the dredging program. This should result in better decisions on dredging dimensions, predicting dredging requirements and understanding placement site effects. The program includes studies, repair, maintenance, and construction work related to wing dams, closing dams, shoreline protection, sediment traps, and other channel control features.

1.3 SCOPE

The Mississippi River is a dynamic, multidimensional resource valued and used for many purposes. The Mississippi River has been recognized by Congress as both a nationally significant ecosystem and a nationally significant commercial navigation system. The Pool3/Upper Pool 4 Channel Management study addresses channel management from a system perspective, considering fish and wildlife, recreational, and cultural resource problems and opportunities as well as channel maintenance and navigation problems and opportunities.

Channel management planning is taking place concurrently with other river resource planning efforts in such areas as water level management, recreation, and dredged material placement. These other planning efforts need to be taken into consideration as part of channel management planning. In the future it would be desirable to merge the results of these and previous studies in a comprehensive plan for river resource management.

1.4 STUDY AREA DEFINITION

The study area was defined in coordination with Federal and State agencies having management responsibilities on the Mississippi River. Factors considered in the definition of the study area included the channel maintenance area of interest, the scope of potential impacts of channel modifications, resource management objectives for the area, and consideration of the cumulative effects of all other related activities on the river. Hydrodynamic and sediment transport processes were also important considerations in the definition of the study area. Finally, practical considerations entered into the process, such as technical capabilities, time, and funding limitations.

The study area included all of pool 3, extending from Lock and Dam 2 at river mile 815.3 to Lock and Dam 3 at river mile 796.9; and the upper portion of pool 4, extending from Lock and Dam 3 to the head of Lake Pepin at river mile 784.0. The lateral boundaries of the study area are the limits of the river floodplain. Plate 1 is a general location map, while plates 2 through 5 show the study area. (It should be noted that the wing dam numbering system shown on plates 2 through 5 is that used when the wing dams were originally constructed prior to the construction of the locks and dams. Thus, there may be duplicate number in any given pool. These numbers are shown for reference purposes only. During project planning, wing dams were referenced by river mile.)

Lock and Dam 3 controls water levels for the lower St. Croix River to Stillwater, Minnesota (about 25 miles). However, the St. Croix River is not included in the study area.

1.5 RELATED STUDIES/PROJECTS

The following studies and projects addressing channel maintenance, resource management, land use, and recreational planning in pool 3 and upper pool 4 have relevance to this study.

1.5.1 9-FOOT NAVIGATION CHANNEL PROJECT ENVIRONMENTAL IMPACT STATEMENT

This document, completed in 1974, assesses the environmental effects of the operation and maintenance of the 9-Foot Navigation Channel project within the St. Paul District.

1.5.2 GREAT RIVER ENVIRONMENTAL ACTION TEAM STUDY (GREAT I)

This 9-volume report (completed in 1980) documents the results of the 5-year Great River Environmental Action Team study for the St. Paul District reach of the Mississippi River. The report contained numerous recommendations for improved management of the river, the most important of which was a 40-year plan for dredged material placement for all of the historic dredging locations in the St. Paul District. Many of the study's recommendations have been implemented. Of particular application to this study is GREAT I further study item #2 which states - "A plan should be developed to use the river's sediment transport capability to cause necessary dredging requirements to occur near long-term placement sites as environmentally and economically feasible."

1.5.3 LAND USE ALLOCATION PLAN

This 1983 plan is the result of a joint effort by the St. Paul District and the U.S. Fish and Wildlife Service. The plan designates Federally owned land from the head of navigation to Lock and Dam 10 for one of five uses - (1) project operations, (2) recreation/intensive use, (3) recreation/low density, (4) natural area, or (5) wildlife management. Approximately 94 percent of the Corps fee-title land in pool 3 is designated for wildlife management use and approximately 5 percent for recreational use, with the remaining 1 percent designated for project operations. Corps fee-title land in upper pool 4 in minimal, restricted to a few acres immediately downstream of Lock and Dam 3.

1.5.4 CHANNEL MAINTENANCE MANAGEMENT PLAN

This 1996 plan and accompanying environmental impact statement is the St. Paul District's plan for management of channel maintenance. Much of the plan is devoted to the designation and design of dredged material placement sites. Included in this report is the District's proposed program for channel management. This channel management study for pool 3 and upper pool 4 is part of that program.

1.5.5 POOL 3/UPPER POOL 4 RECREATIONAL BEACH PLAN

The St. Paul District, in cooperation with river resource management agencies, has been developing recreational beach plans for the navigation pools within the St. Paul District. A Recreation Beach Management Plan for pool 3 and upper pool 4 was completed in December 1998.

1.5.6 RECREATIONAL BOATING STUDIES CONDUCTED IN 1989, 1991, 1993, 1995, 1997, AND 1999.

These reports document recreational boating data collected from aerial photography taken over the main channel and selected backwaters within the St. Paul District portion of the Upper Mississippi River. The data includes boat counts (both moving and beached, backwater or main channel), and types. The reports also summarize Corps of Engineers lock use data.

1.5.7 INTERAGENCY HYDRAULIC EVALUATION TEAM

The Interagency Hydraulic Evaluation Team (IHET) was created under the auspices of the River Resources Forum (RRF) to improve Mississippi River navigation channel planning and study, with emphasis on hydrodynamics and sediment transport. The IHET developed a set of draft guidelines for use in studies such as the Pool 3/Upper Pool 4 Channel Management Study (appendix A).

1.5.8 WATER LEVEL MANAGEMENT STUDY

Partial pool drawdown during the growing season has been identified as a potential tool for enhancing condition for the growth of aquatic vegetation, especially emergent aquatic vegetation which has been in decline in Upper Mississippi River navigation pools. A feasibility study for a pilot pool drawdown of pool 8 has been completed recommending implementation of a drawdown in 2001. If implementation of a pilot drawdown in pool 8 shows that drawdown is a feasible management option for navigation pools within the St. Paul District, pools 3 and 4 would be candidates for use of this management measure in the future.

1.5.9 LOCK AND DAM 3 EMBANKMENT PROJECT

Unlike other locks and dams within the St. Paul District, there was no large earthen dike constructed across the floodplain to maintain navigation pool 3. Instead, maintenance of pool 3 relies upon some shorter dikes near the lock and dam, and a series of low dikes ("spot dikes") along the Wisconsin and Minnesota shoreline upstream of the lock and dam. The integrity of the Wisconsin spot dikes is dependent upon the presence of two private dikes located just downstream of Lock and Dam 3. Over the years, the private dikes have deteriorated and there is concern with the long-term reliability of this dike system. The St. Paul District is currently evaluating options for insuring the long-term reliability of the dike system on the Wisconsin side of pool 3.

1.5.10 LOCK AND DAM 3 OUTDRAFT CONDITION

There is an outdraft problem at Lock and Dam 3 for down bound barge tows. The St. Paul District completed a safety study in 1995 (Corps of Engineers, 1995) which recommended construction of a guard wall extending approximately 1,230 feet upstream of the intermediate wall at Lock and Dam 3 and excavation along the right descending bank immediately above the upper guide wall. This project is currently being reevaluated as part of the Lock and Dam 3 embankment study noted above.

1.5.11 GOOSE LAKE HABITAT REHABILITATION AND ENHANCEMENT PROJECT

Goose Lake and several other area lakes in the Vermillion River bottoms lying landward of the Prairie Island area have poor habitat quality due to sedimentation and a lack of aquatic vegetation. A plan was developed under the UMRS-EMP habitat projects program in the early 1990's for the construction of water control structures and a pump station that would permit the periodic drawdown of the Vermillion River bottoms to promote increased plant growth. The project was never implemented due to conflicts with landowner uses around one of the lakes.

1.6 RELATED AUTHORITIES

1.6.1 SECTION 1135 OF WRDA 1986, AS AMENDED

Section 1135 of the Water Resources Development Act (WRDA) of 1986, as amended, authorizes the Corps of Engineers to modify Corps of Engineers water resource projects for the purpose of improving the quality of the environment. The following summarizes the basic provisions/guidance for Section 1135 projects.

a. If it is determined that construction or operation of a project constructed by the Corps of Engineers has contributed to the degradation of the quality of the environment, measures can be undertaken for restoration of environmental quality. Measures may be implemented either at the project site or at other locations that have been affected by the construction or operation of the project.

b. Section 1135 projects must be cost shared on a 75 percent Federal - 25 percent non-Federal basis.

c. The non-Federal sponsor is responsible for providing all lands, easements, and rights-of-way, and for project operation and maintenance in most instances.

d. The acquisition of additional lands should be kept to a minimum.

e. The Federal cost limit per project is $5,000,000 ($6,666,666 total project cost).

f. The Section 1135 project must be consistent with the authorized purpose of the project.

g. Study-only proposals will not be funded.

h. Studies that may result in an operational-only change, which can be accomplished without additional cost should be pursued under operation and maintenance or other authorities.

1.6.2 SECTION 204 OF WRDA 1992, AS AMENDED

Section 204 of the Water Resources Development Act of 1992 authorizes the Corps of Engineers to carry out projects for the protection, restoration, and creation of aquatic and ecologically related habitats, including wetlands, in connection with construction, operation, or maintenance of an authorized Federal navigation project. In essence, this authority provides for the use of dredged material for the improvement of aquatic and ecologically related habitats. The following summarizes the basic provisions/guidance for Section 204 projects.

a. Section 204 projects are cost shared on a 75 percent Federal - 25 percent non-Federal basis.

b. The non-Federal sponsor is responsible for providing all lands, easements, and rights-of-way, and for project operation and maintenance.

c. Section 204 costs are limited to the incremental costs in excess of those costs necessary to maintain the navigation project in the most cost-effective way, consistent with economic, engineering, and Federal environmental criteria. For example, if it would cost $100,000 to place dredged material in an acceptable placement site and $150,000 to place the dredged material in a manner that would improve aquatic habitat, the non-Federal sponsor would be required to cost-share only the $50,000 incremental cost needed to obtain the habitat benefits.

1.6.3 SECTION 206 OF WRDA 1996

Section 206 of the Water Resources Development Act of 1996 authorizes small, aquatic ecosystem restoration projects. Projects must be cost shared on a 65 percent Federal - 35 percent non-Federal basis. The non-Federal sponsor must also assume responsibility for the operation and maintenance of the project. As opposed to Section 1135 authority, no linkage to an existing Corps of Engineers project is required.

1.6.4 SECTION 1103 OF WRDA 1986, AS AMENDED

Section 1103 of the Water Resources Development Act of 1986, as amended, authorized what is commonly referred to as the Upper Mississippi River System Environmental Management Program (UMRS-EMP). An important component of the UMRS-EMP is the Habitat Rehabilitation and Enhancement Projects (HREP) program. Under this program, habitat projects are being constructed throughout the Upper Mississippi River system. Projects constructed within a National wildlife refuge are constructed at 100 percent Federal cost. Projects constructed on non-refuge lands must be cost shared on a 65 percent Federal - 35 percent non-Federal basis.

EXISTING SETTING

2.1 PHYSICAL SETTING

Pools 3 and 4 are part of the Upper Mississippi River system. Pool 3 was created in 1938 by the completion of Lock and Dam 3. Pool 3 is 18.4 miles long, extending from river mile 796.9 to river mile 815.3. The project pool elevation is 675.0 feet above mean sea level. Pool 3 surface area is approximately 17,950 acres at this elevation.

Pool 3 has a total drainage area of about 45,170 square miles. The only large tributary entering pool 3 is the St. Croix River at river mile 811.5 at Prescott, Wisconsin. The St. Croix River has a drainage area of approximately 7,650 square miles.

Pool 4 was created in 1935 by the completion of Lock and Dam 4. Pool 4 is 44.2 miles long, extending from river mile 752.7 to river mile 796.9. The project pool elevation is 667.0 feet above mean sea level. Lake Pepin, a large river lake, comprises most of pool 4, extending over 22 miles from river mile 763.5 to about river mile 786.0.

Two Minnesota tributaries enter upper pool 4, the Vermillion River and the Cannon River. Both of these rivers enter upper pool 4 less than 2 miles below Lock and Dam 3.

2.2 WATER RESOURCES

2.2.1 UPPER MISSISSIPPI RIVER

Early summer (June) discharges at Lock and Dam 3 generally range from 10,000 to 35,000 cubic feet per second (CFS)). By late summer, discharges usually decrease to 5,000 to 20,000 cfs. Winter low flows are generally in the range of 5,000 to 15,000 cfs. Table 2-1 shows the discharges and stages associated with the various high runoff events for the Mississippi River at Lock and Dam 3.

Table 2-1
Mississippi River Discharge Frequencies - L/D 3

Event	L/D 3 Flow	Pool Elev.	Last Time Exceeded
5-year (20% chance)	89,000 cfs	680.3	May 2001
10-year (10% chance)	114,000 cfs	682.2	May 2001
50-year (2% chance)	173,000 cfs	685.8	April 2001
100-year (1% chance)	201,000 cfs	687.1	April 1965

2.2.2 ST. CROIX RIVER

The St. Croix River has a watershed of approximately 7,650 square miles, draining a watershed in northwestern Wisconsin and northeastern Minnesota that is a mixture of forest and agricultural land. The lower 25 miles of the St. Croix River is a large river lake, Lake St. Croix. This lake acts as settling basin for sediments carried by the St. Croix River. Thus, the St. Croix River water entering the Mississippi River has a much lower level of suspended solids.

2.2.3 VERMILLION RIVER

The Vermillion River is located in Minnesota and has a watershed of approximately 215 square miles that is predominantly agricultural. The Vermillion River parallels the Mississippi River for much of pool 3 and is lower in elevation than pool 3. A series of spot dikes along the Minnesota side of the navigation channel in pool 3 keep the navigation pool from spilling over into the Vermillion River basin during normal river stages.

2.2.4 CANNON RIVER

The Cannon River is located in Minnesota and has a watershed of approximately 1,440 square miles that is predominantly agricultural. The Cannon River enters upper pool 4 between Lock and Dam 3 and Red Wing, Minnesota.

2.2.5 WISCONSIN CHANNEL

The Wisconsin Channel is a major secondary channel in upper pool 4 branching off the navigation channel to the left at about river mile 793.3. This channel roughly parallels the navigation channel all the way to the head of Lake Pepin. The Wisconsin Channel conveys about 24 percent of the total river flow.

2.3 WATER QUALITY

In pool 3 and upper pool 4, water quality is affected by the Minnesota River, the large upstream urban areas adjacent to pool 2 and above, and morphology which allows contaminants and nutrients to either be deposited or move with the river's bedload. Lake Pepin, in particular, is an important morphological feature that acts as a sink for fine materials and the nutrients and contaminants adsorbed to them. Water and sediment quality have improved in pools 3 and upper 4 since the 1970's, but remain more degraded than found in the St. Paul District pools below Lake Pepin.

The general water chemistry of pools 3 and upper 4 of the Mississippi River is considered adequate to maintain most aquatic life. Except in isolated sloughs and backwater lakes, the dissolved oxygen content of the water remains high year round and above levels required to sustain a quality fishery. Because of its turbulent nature and large flow, the river is well aerated and it can assimilate a considerable biochemical oxygen demand (BOD) loading. The high suspended sediment load from the Minnesota River greatly influences suspended solids concentration levels in this reach.

Sediments in the main channel that are dredged in pools 3 and upper 4 to maintain the navigation channel contain an average of 3 and 10 % fine material, respectively. Contaminants are found in the main channel sediments in this reach. Many contaminants exceed the values in the main channel recorded downstream of Lake Pepin by the St. Paul District (Corps of Engineers, 1997).

Steingraeber et al (1994) found PCBs in mayflies from the Mississippi River between Minneapolis, Minnesota and St. Louis, Missouri to be highest in pool 2, followed by pools 3 and 4 (Lake Pepin). Between Minneapolis, Minnesota and Dubuque, Iowa, Sullivan (1995) found similar results in suspended sediments. Hinkro and Moody (1998) and Rostad et al (1997) found similar results in surficial sediments, but found Lake Pepin to contain the greatest concentrations. Sullivan (1995) did not find a consistent change in PCBs in suspended sediments from 1987 to 1994, indicating that PCBs enrichment of the upper pools is continuing from direct or diffuse inputs. Other organochlorines, like DDE, dieldrin, and endrin, were found in surface sediments by Hinkro and Moody (1997) and Rostad et al (1997) at higher levels in the upper pools, than below Lake Pepin. Pereira et al (1995) found many of the presently used pesticides and herbicides in modern agricultural practices in water from the Minnesota River, with similar water concentrations in pools 2, 3 and 4. The St. Croix River had lower levels.

The Minnesota River and municipal wastewater discharges for the Twin Cities area are major sources of nutrients to the upper pools. Nitrates, phosphorus, and ammonia nitrogen have relatively high levels in pool 2 (Antiweiler et. al.1995), although ammonia nitrogen levels have declined significantly over the last 20 years due to pollution abatement. Lake Pepin acts as a settling basin for many of the enriched nutrients, especially phosphorus. Because of the nutrient enrichment and longer hydraulic retention times, Lake Pepin has algal blooms that can cause significant temporal swings in dissolved oxygen. Many metals in water and sediments follow a

similar distribution pattern to PCBs, pesticides, and nutrients (Corps of Engineers, 1997). Metals like lead and cadmium are enriched from urban runoff and waste treatment in the Twin Cities. More ubiquitous metals like zinc, copper, and chromium show less of a distribution pattern.

2.4 VEGETATION

The prevalent vegetation type found in the river floodplain is mixed lowland hardwoods, including elms, willows, and maple species. In the backwater areas, beds of emergent vegetation such as arrowhead and bulrush border the side channels and sloughs. Beds of water lilies can be found in some of the backwater areas, as can lotus beds. In pool 3, isolated backwater lakes like Mud Hen Lake, Sharp Muskrat Lake, and Twin Lakes contain extensive submersed, floating leaf, and emergent vegetation beds. The larger, less isolated North and Sturgeon Lakes contain limited aquatic vegetation, mainly along the edges and the side channel deltas.

The quality of aquatic vegetation in upper pool 4 backwater lakes is also highly variable. Many of the contiguous lakes in the Vermillion River floodplain, such as Goose and Clear Lakes, have limited aquatic vegetation, despite being very shallow. The Rattling Springs Lakes, located adjacent to the Vermillion River, contains luxuriant, diverse beds of aquatic vegetation, presumably because of the spring-fed nature of these lakes. Marsh Lake, which was isolated by the lock and dam 3 spot dike system, also contains abundant aquatic plants. The Cannon River historic floodplain contains extensive stands of emergent vegetation. The contiguous Upper and Lower Mud Lakes, Dead Slough Lake, Goose Lake, and others have more limited vegetation, with a small fringe of emergent vegetation and some floating leaf and/or submersed vegetation.

2.5 FISH AND WILDLIFE

Much of the Minnesota side of the 19-mile-long pool 3 is separated from the main channel by a series of islands. Many of the backwaters protected by these islands areas are managed by the Minnesota Department of Natural Resources (MDNR) as the Gores Wildlife Area. Some of the lands reserved for use by the Prairie Island Sioux tribal community are also managed for their fish and wildlife resources. The upper portion of pool 3 is more riverine in nature than the lower. The Vermillion River branches as it enters the floodplain, flowing both north to enter the Mississippi River near Hastings; and south, emptying into the Mississippi River just south of lock and dam 3. Floodplain lakes and sloughs are also found throughout the pool. Aquatic vegetation is limited in many of these floodplain lakes, like Goose and Clear Lake, because of poor water quality in the Vermillion River.

In upper pool 4, the main channel takes a sinuous route past Red Wing about 11 miles to the upper end of Lake Pepin. Mud, Goose, and Dead Slough Lakes are backwater areas found on the Wisconsin side of upper pool 4. While middle and lower pool 4 are not part of this project, they include some significant recreational and wildlife resources. Lake Pepin is a 22-mile natural impoundment formed by the delta of the Chippewa River; it is a significant feature in pool 4. The U.S. Fish and Wildlife Service manage the majority of the delta as a natural area (Nelson Trevino Research and Natural Area).

Both pools lie in the driftless area of southeastern Minnesota and southwestern Wisconsin. This area was not covered during the most recent glaciation thus the local topography is a product of erosive, not glacial forces. Many of the cities and towns along this stretch of the Mississippi have been developed on terraces developed as the river receded, and on islands in the river or deltas of creeks and rivers that feed the Mississippi.

Pool 3 and upper pool 4 have good, diverse habitat for both fish and wildlife. Habitat types present in the pools include most of the classifications of Wilcox (1993). The most prevalent aquatic habitats include main channel, channel border, slough, river lakes, and tailwater. The important characteristics of these habitat types, relative to fish and wildlife uses are described below.

Main channel - The main channel usually conveys the majority of the river flow during non-flood periods and in most reaches includes the navigation channel. It has a minimum depth of 9 feet and a minimum width of 400 feet. A current always exists, varying in velocity with water stages. The bottom type is mostly a function of current. The upper section usually has a sand bottom, changing to silt over sand in the lower section. Patches of gravel are present in a few areas. No rooted vegetation is present.

Main channel border - Main channel borders are the areas between the navigation channel and the riverbank. Channel borders contain the channel training structures (wing dams, closing dams, revetted banks) and thus a diversity of depths, substrates, and velocities can be found in this habitat type. The bottom is sand in the upper section of the pool and silt in the lower.

Definable plant beds are frequently absent, but single species submersed plant clusters are sparsely scattered in areas of reduced current.

Secondary channel - Secondary channels are large channels that carry less flow than the main channel. Undercut or eroded banks are common along the channels' departure from the main channel. The bottom type usually varies from sand in the upper reaches to silt in the lower. In the swifter current there is no rooted vegetation, but vegetation is common in the shallower areas having silty bottoms and moderate to slight current.

Sloughs - Sloughs are characterized by having no current at normal water stage, mud bottoms, and an abundance of submerged and emergent aquatic vegetation. These areas provide excellent spawning, nesting, and rearing areas, although sedimentation and loss of vegetation are causing a decline in the fish and wildlife habitat values of these areas.

River Lakes and Ponds - River lakes and ponds are distinct lakes formed by fluvial processes or are artificial (excavated or impounded). They may or may not have a slight current, depending on their location. Most of the bottoms are mud or silt, often consisting of a layer two or more feet thick. Aquatic vegetation in these bodies of water can be highly variable. Emergent vegetation is generally restricted to the perimeter of these water bodies.

Tailwaters - Tailwaters are the main channel areas downstream of the navigation dams with deep scour holes, high velocity, and turbulent flow. The bottom is mostly sand. No rooted vegetation is present.

2.5.1 WILDLIFE

A variety of mammals and birds inhabit the floodplain forests and wetlands that remain adjacent to pools 3 and 4. The habitat available is more expansive in lower pool 3 and just above Lake Pepin in pool 4 than any other portions of the project area due to the narrow confines of pool 3's upper reaches. These wooded and wetland areas support species including: rodents such as muskrat, beaver, mice, and common rats; moles and shrews, rabbits, red fox and skunks and raccoons. The pools are also within the Mississippi Flyway, thus available habitat is important for migrating birds. The reach contains important nesting habitat for many species of waterfowl. Many species of ducks use the backwater areas and lakes in this reach as brood habitat.

2.5.2 FISH

The quality of the aquatic fauna is directly affected by water quality. In pools 3 and 4 water quality is affected by its proximity to the large upstream urban areas adjacent to pool 2, and morphology which allows contaminants and nutrients to either be deposited or move with the river's bedload. Lake Pepin, in particular, is an important morphological feature that acts as a sink for fine materials and the nutrients and contaminants adsorbed to them. Important backwater areas in pools 3 and upper 4 include the North/Sturgeon Lake complex, as well as Mud, Dead Slough, and Goose Lakes along the Wisconsin channel across from Red Wing, Minnesota. Other important factors influencing water quality can be tributaries. Fuller (Fuller, 1979) in comparing mussel fauna in the St. Croix and Mississippi rivers suggested that the St. Croix favorably influences the water quality of the Mississippi downstream of their confluence.

The fishery of pools 3 and 4 are considered quite productive. The establishment of pools caused the river to be more lake-like; species composition reflects this. Pitlo et al. (1995) list 72 species present in pools 3 and 4 as uncommon to abundant. In addition, 11 species are listed as rare or noted only from historical records. Game fish found in the pools include northern pike, walleye, sauger, yellow perch, white bass and a variety of centrarchids. Rough fish including carp, buffalo, catfish and drum dominate the commercial catch. Pool 4, especially Lake Pepin, is one of the most productive pools in terms of pounds of fish caught. North and Sturgeon lakes provide the most expansive backwater areas for spawning and rearing. The large number of wing dams, rock structures that direct flow into the main channel in the pools can provide habitat diversity for some benthic fauna and fish species.

Conditions for invertebrate fauna generally improve as one goes downstream from the urban, metropolitan areas of the river. Fuller describes the mussel fauna in pool 3 as being limited but viable and in stark contrast to that found in pools 1 and 2. Recently, the Higgins' Eye Pearly Mussel (*Lampsilis higginsi*), a federally listed endangered species, was found within the proposed construction site for the replacement of a bridge at Prescott, Wisconsin. Pool 4, including Lake Pepin, has known historically almost the entire mussel fauna of the Upper Mississippi River. Recently, a rich mussel bed was found below lock and dam 3, with 27 species found in the survey (Yager 1999). Lake Pepin also has a good mussel fauna.

2.6 THREATENED AND ENDANGERED SPECIES

Pool 3 and upper pool 4 are within the occurrence area of a federally listed endangered species, the Higgins' eye pearly mussel (*Lampsilis higginsi*). As noted above, Higgins' eye mussels were found in the Mississippi River near the mouth of the St. Croix at Prescott, Wisconsin. In some areas of the pools, the quality of the habitat for mussels is reduced by the heavy bedload and the frequent dredging required for maintaining the 9-foot navigation channel. The bald eagle, (*Haliaeetus leucocephalus*), a federally listed threatened species, also uses habitat within the project area. Wintering habitat is found along the river for bald eagles. There area at least two eagle overwintering roosts in the study area, one near the confluence of the Vermillion River with the Mississippi River and one between Red Wing and Wacouta. Downstream of the project area in lower pool 4 at Reads Landing, a high concentration of wintering eagles is present annually.

Seven plant species of special concern are found in this reach. All but one are listed by the states of Minnesota or Wisconsin as endangered. The Illinois tick-trefoil is listed as threatened in Minnesota. None of these species have Federal designation. The bladderpot, prairie plum, dotted blazing star, and Carolina anemone are all found in Pierce County, Wisconsin, near Gantenbein Lake

Table 2-2
Protected Plant Species of the Mississippi River
Pool 3 and Upper Pool 4

Species	Federal Status	MN Status	WI Status	Site Occurrences by County
Bladderpod	--	E	T	Goodhue/Pierce
Carolina Anemone	--	--	E	Pierce
Dotted Blazing Star	--	--	E	Pierce
Illinois Tick-Trefoil	--	T	--	Dakota
James' Polanisia	--	E	--	Dakota
Kitten-Tails	--	E	T	Dakota
Prairie Plum	--	--	E	Pierce

E = listed as endangered **T** = listed as threatened

Nine species of fish, listed by Minnesota and/or Wisconsin as either endangered or threatened are found within pools 3 and/or 4 (table 2-3). Most of these species are large river species, preferring flowing water at least for some stage of their life cycle. The Higgins' eye pearly mussel has historically been recorded for this reach of river. Six mussel species, listed as endangered or threatened by Wisconsin and/or Minnesota were recently collected below lock and dam 3 (Yager 1999). Several other State-listed fish and mussel species not listed in table 2-3, such as the ebony shell, have historically occurred in pools 3 and 4, but have not been recorded in recent surveys.

Table 2-3
Protected Aquatic Species of the Mississippi River
Pool 3 and Upper Pool 4

Species Mussels and Fish	Federal Status	Minnesota Status	Wisconsin Status	Site Occurrences by Pool
Butterfly (*Ellipsaria lineolata*)	--	T	E	Pool 4
Higgins' eye pearly mussel (*Lampsilis higginsi*)	E	E	E	Pool 4
Monkeyface (*Quadrula metanerva*)	--	T	T	Pool 4
Mucket (*Actinonaias ligamentina*)	--	T	--	Pool 4
Pistolgrip (*Tritogonia verrucosa*)	--	T	T	Pool 4
Wartyback (*Quadrula nodulata*)	--	E	T	Pool 4
Washboard (*Meglonaias nervosa*)	--	T	--	Pool 4
Black buffalo (*Ictiobus niger*)	--	--	T	Pool 4
Blue sucker (*Cycleptus elongatus*)	--	SC	T	Pool 3 & 4
Goldeye (*Hiodon alosoides*)	--	--	E	Pool 3 & 4
Greater redhorse (*Moxostoma valenciennesi*)	--	--	T	Pool 3 & 4
Paddlefish (*Polyodon spathula*)	--	T	T	Pool 3 & 4
Pallid shiner (*Notropis amnis*)	--	--	E	Pool 4
River redhorse (*Moxostoma carinatum*)	--	--	T	Pool 3 & 4
Skipjack herring (*Alosa chrysochloris*)	--	SC	E	Pool 4
Speckled chub (*Macrhybopsis aestivalis*)	--	--	T	Pool 3 & 4

E = listed as endangered **T** = listed as threatened **SC** = Special Concern

Three protected wildlife species are found in this reach (table 2-4). The bald eagle is the only wildlife species with Federal protection under the Endangered Species Act. The bald eagle is Federally listed as threatened in Minnesota and Wisconsin. The Blanding's turtle and wood turtle are listed as threatened in Minnesota and Wisconsin.

Table 2-4
Protected Wildlife Species of the Mississippi River
Pool 3/Upper Pool 4

Species	**Federal Status**	**Minnesota Status**	**Wisconsin Status**	**Site Occurrences by County**
Bald Eagle	T	T	T	Dakota, Goodhue, Pierce, Pepin
Blanding's Turtle	--	T	T	Dakota, Goodhue
Wood Turtle	--	T	T	Washington, Goodhue

E = listed as endangered   **T** = listed as threatened

2.7 CULTURAL RESOURCES

Pool 3 and upper pool 4 contain a number of landforms that have attracted human use and habitation for millennia. These include the Cannon and Trimbelle river deltas, the many large glacial terraces of the area such as Prairie Island, and the head of Lake Pepin. Some 155 archaeological and historic sites are known for pool 3, and 304 for pool 4. Many of these are the large mound and habitation sites of the Red Wing area, representing one of the major concentrations of human activity in the entire Upper Midwest about 1000 years ago. The bluffs, terraces, river deltas and natural levees still contain the material remains of this thriving Oneota society, as well as those that preceded it. More than 2000 mounds, as well as other earthworks, village sites, lodge circles and stone cairns were mapped in the region in the late nineteenth century. The historic sites known in the project area include structures and historic districts in the city of Hastings. The components of the Upper Mississippi River 9-foot Channel project are also historic properties. Locks and Dams 3-10 have been determined eligible for the National Register of Historic Places. Lock and Dam 2, which was authorized and constructed before the authorization of the 9-foot channel project, is considered not eligible. The wing dams, which were constructed before the 9-foot channel as improvements to the navigation channel, are currently being evaluated as historic properties.

Most of the known sites in pool 3 and upper pool 4 are on higher ground away from the shoreline. In the more immediate areas that may be affected by the construction or operation of the features of this channel management project, only three historic properties are known at this time. These are Lock and Dam No. 3; the wing dams and other pre-9-foot channel constriction works; and 21 DK 58, the historic Samuelson farmstead on the shore adjacent to Carter Slough. Sites are also known on the shores of North and Sturgeon Lakes, especially on the shores of Prairie Island terrace. In the other project areas such as Four-Mile Island, Big River, Coulter's Island, and Morgan Coulee, no sites are known on the shorelines. The western shorelines in these areas were formed by vertical accretion. There are several main channel islands present. These landforms have a moderate potential for containing intact archaeological deposits, especially if deeply buried.

2.8 SOCIOECONOMIC SETTING

The cities (or communities) of Hastings, Minnesota, Prescott, Wisconsin, Diamond Bluff, Wisconsin, and Red Wing, Minnesota, are all located within the study area. Hastings is located just downstream of Lock and Dam 2, while Prescott is located at the mouth of the St. Croix River. Diamond Bluff is located in the lower portion of pool 3 at river mile 800.0. Red Wing is located in upper pool 4, approximately midway between Lock and Dam 3 and the head of Lake Pepin.

Primary highways either closely parallel the shorelines for considerable distance along both sides of the pools or follow the nearby high-terraced areas within the valley in the same general north-to-south direction. Networks of secondary, county, and township roads connect with the primary roads to service the areas adjacent to the pools and to provide access from outlying areas. There are two bridge crossings in the study area. The U.S. Highway 61 bridge spans the river at Hastings, about 1.3 miles below Lock and Dam 2. The U.S. Highway 63 bridge is located at Red Wing.

The Prairie Island Sioux Tribal community is located in lower pool 3 on the Minnesota side of the river.

2.9 RECREATION

Pool 3 and upper pool 4 contain three major state fish and wildlife management areas (table 2-5). No national wildlife refuges are found within this study reach.

Table 2-5
Fish and Wildlife Management Areas
Mississippi River: Pool 3 and Upper Pool 4

Management Areas	State	County	Pool	Type
Ravenna State Wildlife Mgmt Area	MN	Dakota, Goodhue	3	S
Gores State Wildlife Mgmt Area	MN	Goodhue	4	S
Pierce County Islands Wildlife Area	WI	Pierce	4	S

Type: Federal (F), State (S), Local (L)

The Ravenna and Gores State Wildlife Mangement Areas (WMAs) are located southeast of Hastings and contains several lakes of varying sizes, including Mud Hen Lake, Sharp Muskrat Lake, Twin Lakes, and North Lake. A portion of the Vermillion River is adjacent to the Gores Pool area. Fishing, hunting, and hiking opportunities are available. The Gores and Ravenna State Wildlife Management areas provide important habitat for a diversity of wildlife species. The Pierce County Islands public area in upper pool 4 contains important habitat for various species of shore and wading birds.

Pool 3 and upper pool 4 have one natural area, the Hastings State Natural Area, located near the city of Hastings. This state owned area is known for wildflowers.

This study reach contains 8 major recreation areas. All are in Minnesota and owned by local units of government. No Federal recreational areas occur within this study reach. Camping was the most commonly available recreation opportunity along this study reach. Picnicking, hunting/fishing, hiking/biking, and water activities were less common. The 8 recreation areas and the activities they provide are listed in table 2-6.

Recreational boating is a popular activity in pool 3 and upper pool 4, especially in conjunction with boat beaching sites for activities such as swimming, picnicking, and camping. A Recreational Beach Management Plan was completed for pool 3 and upper pool 4 in December 1998 (Corps of Engineers, 1998). That plan identified 36 sites used for recreational beach activities. The plan recommends that recreational beaches be maintained at the eight locations shown in table 2-7.

Table 2-6
Recreation Areas
Mississippi River: Pool 3/Upper Pool 4

Recreation Area	State	County	Pool	Acres	Type	Camping	Picnicking	Hunting/ Fishing	Hiking/ Biking	Water Activities
Lake Rebecca Municipal Park	MN	Dakota	3	ND	L	--	--	--	X	X*
Levee Municipal Park	MN	Dakota	3	ND	L	ND	ND	ND	ND	ND
Point Douglas County Park	MN	Dakota	3	7	L	--	X	--	--	X
Bay Point Park	MN	Goodhue	4	ND	L	--	X	--	--	X*
Levee Municipal Park	MN	Goodhue	4	ND	L	--	X	--	--	--
Barn Bluff Municipal Park	MN	Goodhue	4	ND	L	--	--	--	X	--
Colvill Municipal Park	MN	Goodhue	4	ND	L	--	X	--	--	X*

Type: Federal (F), State (S), Local (L) **ND** = No Data *Boat Access

Table 2-7
Recommended Beach Maintenance Sites - Pool 3/Upper Pool 4

Location	Recommendation
River Mile 810.2 (left bank)	add material, reshape
River Mile 809.1 (left bank)	add material, reshape
River Mile 807.5 (right bank)	reshape
River Mile 805.5 (right bank)	reshape
River Mile 802.1 (left bank)	emergency dredging placement site
River Mile 799.5 (right bank)	add material, reshape
River Mile 799.1 (right bank)	reshape
River Mile 796.3 (left bank)	add material, reshape

HISTORIC CHANGES

This section summarizes changes to pools 3 and upper pool 4 brought about by various navigation projects and other Federal activities. The purpose is to provide a background for the current conditions in the study area. It is not intended as a detailed description of all the changes that have occurred to the Mississippi River and its basin since European settlement.

3.1 EARLY NAVIGATION PROJECTS

The first navigation modifications and maintenance on the Upper Mississippi River were legislated by Congress in 1824, when the Corps of Engineers was authorized to remove snags, shoals, and sandbars, and to close sloughs and backwaters so that flows were confined to the main channel to maintain depths for navigation.

The first comprehensive modification of the river for navigation was authorized by the River and Harbor Act of 1878. This legislation authorized a 4-foot channel from the mouth of the Missouri River to St. Paul, Minnesota. The 4-foot channel was maintained by constructing dams at the headwaters of the Mississippi River to impound water for low flow supplementation, bank revetments, closing dams, and longitudinal dikes. A 6-foot navigation project was authorized by the River and Harbor Act of 1907. The additional depth for the 6-foot channel was obtained by increased construction of wing dams supplemented by limited dredging. Usually the banks opposite a wing dam field were protected with rock revetments to prevent erosion.

Available records show that a total of about 135 channel control structures in the study area, all but a few of which are located in pool 3. A large percentage were repaired and/or modified in the early 1900's.

These early navigation structures were designed to confine flow to the main channel. The closing dams would have reduced flow down side channels and, in combination with the wing dams, increased velocity and sediment transport in the main channel, resulting in a deeper channel. Sediments accreted between wing dams and in cut-off side channels, converting aquatic habitat to terrestrial habitat. This accretion and conversion is readily evident on pre-lock and dam aerial photographs.

3.2 9-FOOT NAVIGATION CHANNEL PROJECT

The River and Harbor Act of 1930 authorized the 9-Foot Navigation Channel project and led to the construction of a series of locks and dams to provide the necessary water depths. Land that would be affected by the increased water levels was purchased. The Corps purchased approximately 5,600 acres in pool 3. Of this, about 4,125 acres are managed by the Minnesota Department of Natural Resources as State wildlife management areas. The effect of Lock and Dam 4 on upper pool 4 water levels is minimal because of the moderating effect of Lake Pepin. Therefore, the only land purchased in upper pool 4 by the Corps of Engineers was immediately below Lock and Dam 3.

Creation of the pool 3 inundated thousands of acres of land. A study published by the Corps of Engineers (1978) showed the changes in habitat types in pool 3 between 1929 and 1973 (table 3-1). The significant increase in river lakes and ponds acreage and a large portion of the decrease in meadow acreage is likely due to the increased size of North and Sturgeon Lakes as a result of impoundment. During this time period, there was also some succession of meadow habitat to forest habitat.

Table 3-1
Changes in Acres of Habitat Types for Pool 3

Habitat Type	1929	1973	Net Change*
Main Channel	1,332	845	- 487
Main Channel Border	413	1116	+ 703
Side Channels	0	254	+ 254
Sloughs	1,056	1,290	+ 234
River Lakes and Ponds	905	2,725	+ 1,820
Tailwaters	0	72	+ 72
Marsh	1,865	2,911	+ 1,046
Total Aquatic	5,571	9,213	+ 3,624
Forest	6,613	7,582	+ 956
Brush	684	92	- 592
Meadow	3,032	203	- 2,829
Sand	181	79	- 102
Agriculture	5,716	3,381	- 2,335
Residential/Commercial	293	712	+ 419
Total Terrestrial	16,519	12,049	- 4,470

* the totals reflecting the conversion of terrestrial to aquatic habitat do not balance as the study areas used for the two years differed by about 825 acres

Similar data is not available for upper pool 4, as the 1978 study did not separate upper and lower pool 4. Because upper pool 4 is minimally affected by the operation of Lock and Dam 4, the changes in habitat types in upper pool 4 were probably relatively minor.

The effects of creation of the navigation pools have been described in many other studies. They can be synopsized as follows. Creation of the navigation pools created thousands of acres of new aquatic habitat, benefiting those forms of fish and wildlife adapted to this habitat. Major beneficiaries were lentic fish species, waterfowl, marsh and other water birds, and furbearers. Adversely affected were terrestrial wildlife and lotic fish species. The period from creation of the locks and dams through the late 1950's could be termed an "era of plenty" due to the abundant fish and waterfowl resources generated by the newly created aquatic habitats.

As soon as the navigation pools were created, natural processes began to transform them. During the "era of plenty" noted above, these transformations either were not noticed, or were not given much concern by the public. In the 1960's, resource managers and the public began to take more notice of these natural changes, most specifically the filling of backwater habitats with sediments. Sedimentation was probably the most significant resource concern in the 1960's and 1970's, and still is an important concern.

Within the last 20 years, other changes associated with impoundment have become the subject of concern. Some of the more significant are:

a) disruption of the annual hydrograph, as well as the attenuation of hydrograph extremes, especially during drought or low water conditions

b) disruption of the hydraulic processes that would occur in an unimpounded or unconstrained river

c) declines in aquatic vegetation

d) declines in bathymetric diversity

e) forest stand uniformity and succession changes related to a) and b) above

f) loss of islands

Most of these have applicability in pool 3 and upper pool 4, except for the loss of islands. The natural hydrograph has been disrupted by the creation and by the regulation of the pools. Regulation of the pools can attenuate minor high water events, but generally, there is little or no effect on larger flood events. More significant is that maintenance of the pools creates a relatively fixed low water elevation. Water levels do not decline below this point during annual low water periods or during droughts. This interrupts natural physical and biological processes

associated with and/or requiring periodic low water. Impounded areas above the navigation dams experience a leveling effect due to wind wave action eroding the high points and trapped sediments filling in old channels.

The hydraulic processes that would occur in an unimpounded or unconstrained river have also been disrupted. Wing dams, closure structures, and bank protection are all designed to constrain flow to the main channel. This reduces flow to side channels and other backwater areas. It also constrains the river from creating new side channels or sloughs, and from building of new islands and channel levee landforms.

FUTURE CONDITIONS

4.1 OVERVIEW

Planning for the future requires projecting future conditions under various scenarios, including the no action scenario. Corps of Engineers planning regulations (ER 1105-2-100) provide the following guidance concerning this subject. Future without plan conditions are the most probable conditions based on:

a) trend and existing condition information

b) available related forecasts, e.g., land use plans, population projections

c) established institutional objectives and constraints and local customs and traditions, e.g., authorized projects, refuge master plans, local recreational preferences

d) reasonably foreseeable actions of people in the absence of any proposed action

e) reasonably foreseeable natural occurrences, e.g., annual high water, natural succession

4.2 PLANNING HORIZON

A planning horizon is necessary for any planning effort. Planning horizons can range from the very short term (5 years) to the long term (100+ years). The planning horizon should be commensurate with the nature of the planning effort, the scope of the expected products of the planning effort, and the ability to predict future conditions. Channel management planning is considered a mid-range planning effort. Any projects that are implemented will likely be functional for 25 to 50 years, and possibly longer. Structural features may be relatively permanent.

A planning horizon of 50 years was selected because it provides a reasonable balance between the expected life of any recommended solutions and the ability to predict future conditions on the Mississippi River.

Consideration was given to using the 40-year planning used for the planning for long-term dredged material placement sites in the St. Paul District. This was the time frame used in the GREAT I study. There was nothing unique that led the GREAT I study team to select a 40-year planning period, a somewhat unusual time frame. It was simply a matter of convenience. GREAT I channel maintenance planners did not believe that many of the GREAT I recommendations would be implemented until 1985. They selected the year 2025 as the end year for their planning period, probably because it is the quarter century mark. There is little

relationship between this study and long-term dredged material planning, other than any measures implemented to reduce dredging requirements will extend the lifetime of existing dredged material placement sites. Therefore, using the same 40-year planning period that was used for dredged material placement planning was not considered necessary.

Because of the time required to complete this study and implement any recommended actions, and to use rounded years for easier understanding, the 50-year planning period for this study was defined as 2001 to 2050.

4.3 NAVIGATION PROJECT

As described earlier, the existing navigation project has had a significant effect on the river and its landscape. Estimating future conditions relative to fish and wildlife habitats and to recreation and other public uses of the river is highly dependent on the future of the navigation project. Therefore, it is necessary to predict in what form the navigation project is likely to exist during the period 2001-2050.

For this study, it is projected that the 9-Foot Navigation Channel project will continue to exist and function during the period 2001 - 2050 in a manner very similar to the last 60+ years. The locks and dams, supplemented by maintenance dredging, will be required to maintain a 9-foot navigation channel.

One change expected to occur with the project is water level management. Within the 2001-2050 time period, modifications to existing water level management to benefit fish and wildlife will likely be implemented. The exact nature of future water level management will require detailed analysis of potential benefits and negative effects. Options may range from minor adjustments to existing regulation to large-scale drawdowns.

Existing conditions relative to channel maintenance are not expected to change appreciably. Measures that would have a significant effect on maintenance dredging requirements, such as reduced depth dredging and improved channel monitoring, have already been implemented. It is likely that those locations currently requiring frequent channel maintenance (such as in the Diamond Bluff area) would still require frequent maintenance dredging.

4.4 FISH AND WILDLIFE HABITAT

Pool 3 and upper pool 4 are part of the aging impoundment system on the Upper Mississippi River and is experiencing many of the habitat changes that are occurring throughout the system. The biological diversity and abundance of fish and wildlife, including highly valued species, have and will continue to decline as a result of the reservoir aging process. Continued operation and maintenance of the navigation system will produce further changes to the condition of floodplain and aquatic habitats.

4.4.1 PHYSICAL HABITAT CONDITIONS

Future changes in river geomorphology and hydrodynamics will greatly influence the future ecological characteristics of the Upper Mississippi River. Transport and deposition of fine and coarse sediments in an altered hydrologic regime will determine future floodplain morphology. Channel training structures have and will continue to some degree affect river flow and sediment transport.

4.4.1.1 Training Structures

Training structures affect the river at four different spatial scales. These are the local scale (e.g., near the training structure), the river reach scale (e.g., typically a 2- to 10-mile river reach with interdependent hydrodynamics), the navigation pool scale, and the floodplain scale (e.g., multiple pools).

The River and Harbor Acts of 1878 and 1907 authorized the development of 4- and 6-foot channels respectively. These channel depths were achieved through dredging and the construction of wing dams, closing dams, and bank revetments on the Upper Mississippi River during the late 1800's and the early 1900's. In pool 3 and upper pool 4, most of the wing dams were constructed between 1880 and 1900. The construction of training structures (wing dams, closing dams, and bank revetments) had significant impacts on the river at all four spatial scales. Locally, scour holes formed adjacent to wing dam tips and near the shoreline, and sediment deposition occurred in off-channel areas, termed "safe places" in earlier documents. In many cases, these "safe places" were between wing dams where accretions resulted in the formation of "fast land". Training structures caused the number and area of islands to increase, with a concurrent decrease in the surface area of the main channel (Chen and Simons 1979). In pool 5A, Anderson et al. (1983) estimated that 45 percent of the total length of channel structures has been either buried or lost through erosion. Narrowing of the channel with control structures and sediment deposition increased flow velocities and caused bed erosion in the main channel. The construction of closing dams along with sediment accretions in off-channel areas reduced hydrodynamic connectivity affecting river reach and floodplain scale dynamics.

The construction of locks and dams in the 1930's submerged most training structures, significantly changing how they affect river dynamics. On a local scale, the hydrodynamics around training structures continues to be complex. A scour hole usually developed at the tips of

wing dams and at notches in closing dams. Sediment accretion occurred between wing dams and adjacent scour holes. Many training structures provide local diversity and habitat (Anderson et al. 1983 and Pitlo in Burch et al. 1984).

On a river reach scale, the effects of training structures on river planform (configuration of the channels, lakes, islands, and other features found in a river valley) were reduced to varying degrees due to inundation. Nanda and Baker (1983) report that adequate training structures, submerged 3-5 feet below low water surface elevation, are effective. Generally, this means that in the upper and middle reaches of pools they continue to some degree to affect reach specific hydrodynamics and sediment transport. In the lower pools, training structures are more deeply submerged and less effective. In many instances, lower pool structures are buried in sediment.

For submerged wing dams, one equation for the ratio of contracted depth to uncontracted depth was given by Anderson and Davenport (1968) as

$$Yn/Y = (Qc/Q)^{0.857} * (W/Wn)^{0.857}$$

Yn = contracted channel depth
Y = uncontracted depth
Qc = flow in the contracted section
Q = total main channel flow
W = width of main channel
Wn = width of contracted channel

For a 1,000-foot wide channel encroached by 300 feet of wing dams (a typical situation), a contracted section flow to main channel flow ratio (Qc/Q) of 0.7 would result in no effects of wing dams on channel depths (i.e. $Yn/Y < 1$). In other words, if wing dams are submerged enough so that about 30-percent of the total main channel flow is conveyed over them, they are ineffective. In 1994, flow measurements were made over wing dams located at river mile 805.5, 805.6, and 805.7. The flow over each wing dam was equal to 11.1, 18.3, and 21.1 percent of the total river flow, respectively, indicating that these wing dams were fairly effective. The average water depth over these wing dams from normal pool elevation (675.0) was 5.7, 4.8, and 6.1 feet respectively. Based on hydrographic surveys, many wing dams in pool 3 are submerged enough that they probably are not effective.

Inundation also submerged closing dams and created new secondary channels, which increased hydrodynamic connectivity, making all training structures less effective. The increased hydrodynamic connectivity affects both backwater habitat and navigation channel dredging. Based on St. Paul District data, dredge cut location is correlated more closely with secondary channel flows than with training structure density. This is the reason that the reach adjacent North and Sturgeon Lakes requires constant maintenance dredging.

On a navigation pool and floodplain reach scale, the effects of training structures are minimal for existing river conditions. River character at these scales is dominated by manmade

features such as locks and dams and agricultural or flood control levees; post glacial river valley planform; and tributary locations. Currently in pool 3 and upper pool 4, hydrodynamic connectivity (as measured by percent of total river flow in backwaters) varies from 0 to 34-percent, depending on position in the pool.

During the planning horizon (2000 to 2050), and assuming no changes in pool operation or river planform, the impacts of existing training structures will continue to decrease. They will affect local bathymetry, will have varying effects on river reach specific hydrodynamics and sediment transport, but will continue to have minimal impacts on navigation pool and floodplain reach scale dynamics. With time, hydrodynamic connectivity will increase as new secondary channels form connections between the main channel and the backwaters. If pool operation is changed at some point in the future such that lower water levels occur for part of the year, the effects of training structures will increase. Local diversity and downstream sediment transport through a river reach will increase, and flow through backwaters and in the main channel will be influenced since closing dams will be more effective.

4.4.1.2 Sedimentation

Sediment deposition rates found in early sediment investigation varied between 1 and 2 cm/yr (McHenry 1975, Eckblad 1977, Fremling et al. 1976). These early investigators concluded that many backwaters on the Mississippi River would be filled with sediment in 50 to 200 years. In pool 19, Bohmik et al. (1986) concluded that, by the year 2050, the river would change from a lake-like appearance to a river- and floodplain-like environment with an incised channel. However, Chen and Simons (1979), using as one of their tools a one-dimensional water and sediment routing model, predicted a river scene in the Upper Mississippi River 50 years into the future that would be essentially as it is today if no major manmade changes or natural events occur. Stage and discharge relations in the next 50 years would remain essentially as they are today. Geomorphic changes would continue following historical trends, but at a slower rate.

Recent investigations appear to support a slow change hypothesis. Korschgen et al. (1987) found an annual deposition rate of 0.2 cm/yr in Lake Onalaska for the years 1937 to 1983. Rogalla and Boma (1996) found deposition rates (in centimeters per year) of 0.29, 0.12, and 0.80 in pools 4, 8, and 13 respectively. In Weaver Bottoms, historic deposition rates (1932-1986) are 0.18 to 0.22 cm/yr; while more recent deposition rates (1986-1991) have increased to 0.37 cm/yr (Anderson et al. 1993). Reasons for the lower deposition rates found in recent studies are related to both study protocol and physical changes in the river. Early investigations may have focused on deposition areas, while more recent investigations didn't have this bias. Physical and biological changes in the river system have also occurred. As backwater areas accrete sediment, their bed approaches dynamic equilibrium with the hydrodynamic forces affecting sediment movement, such as current velocity and wave action. Daily and seasonal differences in sediment transport affect bed elevations, but accretion rates will have been reduced to pre-colonization levels. Bohwmik et al. (1986) studied pool volume changes in pool 19 and found that the trap efficiency had decreased from 50-percent in the 1920's to 23-percent in the 1970's. In addition, reductions in plant communities may decrease sediment stability and increase hydrodynamic

forces at the sediment-water interface, increasing sediment outflows. James and Barko (1990) found high levels of sediment accretion in vegetated littoral zones of Eau Galle Reservoir, Wisconsin and hypothesized that submersed aquatic plants promote sediment accumulations.

Based on the above discussion, fine sediment will continue to accumulate in backwater areas, though at reduced rates. Bathymetric diversity will decrease and fine sediment movement in backwaters will be dominated by daily variations in wind-driven wave action. Some backwaters may eventually reach a point of quasi-equilibrium between fine sediment transport and hydrodynamic forces, though the physical conditions (shallow depth, unconsolidated bottom sediments, etc.) may not be desirable. Reestablishment of aquatic vegetation could change backwater sediment movement so that it follows a seasonal time scale in sync with flood events. Increased vegetation growth would trap sediment during the growing season, some of which would be removed by wave resuspension and advective transport during fall and spring high water events when vegetation is dormant. The loss of bathymetric, biologic, and subsequently hydrodynamic diversity in backwater areas will limit future dynamic changes in backwater areas. Instead of erosion and deposition zones, corresponding to local bathymetry or plant beds, flow now spreads out across backwaters depositing sediment but lacking the energy to scour sediment.

Coarse sediment transport potential varies longitudinally with the upstream reach of the pool having a high transport potential, the downstream reach having a low transport potential, and the middle reach being a transition between the two regimes. Coarse sediments are transported through the upper reach to the middle reach where shoaling occurs due to the decreased transport potential. Dredging occurs mainly in the middle transition reach, causing a reduction in sediment available to the lower reach. So even though sediment transport potential is lowest in the downstream reach, the sediment load has also been reduced, resulting in minimal channel dredging. Within the main channel, both island erosion and formation occurs, though erosion is the dominant process. In a few reaches of the Mississippi River, coarse sediment transport and hydrodynamic conditions are conducive to island formation. In pool 6, which has the lowest hydrodynamic connectivity, and is probably closest to dynamic equilibrium of any pool in the St. Paul District, island formation and loss is occurring. Jefferson (1995) observed new islands being formed and older islands eroding away in pool 6. This process is not occurring in pool 3 yet.

The trend during the 60-years since inundation has been for increased hydrodynamic connectivity as the number and size of secondary channels increased. This trend will continue through the planning horizon as secondary channels continue to erode. Beyond the planning horizon, continued backwater delta expansion, and colonization of deltas by terrestrial plants, backwater flow resistance eventually will increase, resulting in steeper water surface slopes, deeper channels, increased discharge in the navigation channel; and increased transport of sand into lower pool reaches.

4.4.2 WATER QUALITY

Water quality in pool 3 and upper pool 4 is greatly influenced by the inputs from pool 2 (i.e., the Minnesota River) and the Vermillion and Cannon Rivers bringing agricultural chemicals and suspended sediments into the system. Recent efforts to improve watershed management in the basins of these rivers may eventually reduce sediment loading to the Upper Mississippi River. However, heavy inputs of sediments from these tributaries are likely to continue during the 50-year planning period. Although contaminants have been reduced in this reach of the Upper Mississippi River in recent times (most specifically PCBs), they remain at levels probably affecting the flora and fauna. Contaminants are likely to remain elevated for some time due to the continued input from point and non-point sources, the resuspension of contaminated sediments, and the long "life" of some of the contaminants.

4.4.3 PLANT COMMUNITY

In an unregulated river, water level fluctuations create gradients of soil moisture, which range from complete drowning of plants during high water conditions, to desiccation during periods of low water (Nilsson 1996). These conditions create obvious zones of riparian and aquatic vegetation. These zones fluctuate with episodic events (floods and droughts) and with changes in long-term regional climatic conditions (wet and dry cycles). Low water levels associated with summer and winter low discharges and periodic droughts have not occurred on the Upper Mississippi River since construction of the locks and dams, because minimum project pool elevations are maintained for navigation. This restriction on water levels affects soil moisture gradients and subsequent vegetation zonation. In addition, channelization has reduced the extent of floodplain reconfiguration.

As a result of lock and dam construction, terrestrial habitat within pool 3 (measured from 1929 to 1973) was reduced from 75 percent to 64 percent of the floodplain (Olson and Meyer 1976). The greatest loss was in upland/wetland meadow habitat, which was reduced from 15 percent to 1 percent of the floodplain. In addition, losses in brush and early successional forest occurred, with the more stable water levels following inundation. The floodplain vegetation on the Upper Mississippi River has been continuously adapting to these changed conditions since construction of the navigation dams. Within the 50-year planning horizon, a substantial increase in terrestrial habitat is not likely to occur. However, the general long-term projection for the future is that as backwaters fill in with sediments, there will be a restoration of terrestrial habitat, mainly meadows and floodplain forest.

The aquatic plant community exploded following inundation of large fertile floodplain areas by the locks and dams. However, the aquatic plant community has subsequently declined because of stable water levels, loss of protective islands and bathymetric diversity, wave and current action, and other factors. Since significant changes in riverbed morphology and hydrodynamics are not projected to occur within the 50-year planning horizon, the aquatic plant community is likely to continue in a suppressed mode. Episodic events like the regional drought conditions of the late 1980's caused a temporary partial restoration of the aquatic plant

community, followed by a precipitous decline because of a combination of factors having to do with underwater light penetration and availability of plant nutrients in sediments. Emergent vegetation has not shown a great recovery from the late 1980's drought. Submerged vegetation is very limited in much of pools 3 and upper 4, except in the more isolated backwater lakes, such as Marsh Lake, Rattling Springs, and Mud Hen Lake.

In the future, the aquatic plant community will likely continue to experience reduced levels. Beyond the planning horizon, as the slack water areas continue to fill with sediments, aquatic plant coverage will slowly expand. However, as sedimentation continues, much of the slack-water aquatic areas will be converted to terrestrial habitat, mainly wetland meadows and floodplain forest.

4.4.4 FISH AND WILDLIFE COMMUNITY

Habitat in both pools 3 and upper 4 are somewhat unique. In most pools within the St. Paul District there is large relatively open water area above the dam, because of the greater depth of inundation. This large open water area is generally lacking in pool 3. The spot dikes isolate large portions of the lower floodplain, which prevented the maximum inundation of the area immediately above the dam. In addition, the large elevated sand terrace, Prairie Island, minimized the flooding of the lower part of the pool. Upper pool 4 is also somewhat unique because of the presence of Lake Pepin.

Prior to construction of the 9-foot channel project, the fishery of the pools 3 and 4 were largely dominated by riverine species adapted to a lotic or flowing water environment. With construction of the project and creation of slow moving "backwater" and pool habitat, like North, Sturgeon, and Mud Lakes, a shift in the fishery occurred. Lentic species, notably members of the Centrarchid family, increased in abundance. With the inundation, there was an overall increase in total fish biomass proportional to the amount of new water area. The habitat quality for lentic species has declined in recent years, because of the losses in the aquatic plant community and continued shrinking and isolation of aquatic areas in the upper reaches of the pool. The aging of the impoundments created by the locks and dams will undoubtedly affect the composition of the future fishery. Habitat quality for lentic species is likely to continue to decline within the 50-year planning horizon. Eventually as the middle and lower reaches continue to agrade, habitat quality for lentic species would improve. However, as backwaters continue to slowly fill with sediment, habitat for species adapted to lentic conditions will decline in favor of more lotic species. As aquatic areas are converted to terrestrial habitat there will be a subsequent loss in total fish biomass.

The freshwater mussel resources of the Upper Mississippi River have been greatly impacted by development in the river basin. Qualitatively new conditions for mussels were created by the 9-foot channel project's impoundment of significant stretches of the Upper Mississippi River (Fuller 1980). This introduced new problems for mussels, notably reduction of the movements of fishes that host parasitic mussel larvae and acceleration of sediment accumulation. Additionally, the accelerated sediment accumulation required maintenance

dredging to maintain the channel, which can directly affect mussels. Freshwater mussels in pools 3 and upper 4 are somewhat limited because of the poorer sediment and water quality and the extensive amount of fine sediment loads coming into the pools from the Minnesota, Cannon, and Vermillion Rivers. However, relatively diverse, abundant mussel assemblages can be found in areas with more stable substrate conditions. Recent mussel surveys have indicated an improvement in the mussel community in this reach, presumably because of the significant improvements in water quality that have occurred in this reach since the mid-1970's. The ultimate future of freshwater mussels on the Upper Mississippi River, including pools 3 and 4, is going to be highly dependent on the ability of freshwater mussels to withstand or recover from the onslaught of the colonization of the Upper Mississippi River by the exotic zebra mussel. Veliger and adult populations of zebra mussels appear at present to be limited in pools 3 and upper 4, indicating that the effects of zebra mussels on native mussels may be less severe than in the downstream pools.

The impact of sediment transport to backwater areas depends on the local landscape. In small backwaters, more typical of upper pool reaches, coarse sediment transport is usually viewed as negative. The general reduction in water depths and size of these small backwaters, in combination with reductions in water circulation tends to reduce the value of these areas for desired species of fish and wildlife. In large backwaters more typical of mid and lower pool reaches, such as North and Sturgeon Lakes, coarse sediment transport results in deltaic formations at the terminus of secondary channels. These areas are biologically productive and thus very desirable for certain species of wildlife. However, the marsh and shallow aquatic areas that are filled by delta expansion are also productive for other species of wildlife. This process will continue in backwaters, but at a relatively low rate. Finer sediments tend to accumulate in deeper water areas with limited current, filling in these critical areas for fish.

Wildlife use of the pools 3 and upper 4 floodplain will continue to change as the physical habitat conditions in this reach. Waterfowl and other species of birds and aquatic mammals that depend on a healthy marsh have declined in pools 3 and upper 4 because of the declining aquatic vegetation. This will likely continue to be below historic use levels until the vegetative community shows greater recovery. Eventually, beyond the 50-year planning horizon, as the backwaters fill in and more marsh and shallow aquatic habitat is created, use by waterfowl and other species of marsh wildlife will increase.

4.5 RECREATION AND PUBLIC USE

The primary change to recreation and public use in the study area during the period 2001-2050 will be the increased demands associated with population growth. The focus of recreation activities will still be the river and associated floodplain habitats. The primary recreational activities are not expected to change significantly from those that are popular today, e.g., fishing, hunting, trapping, boating, camping, swimming, and picnicking. Shallower depths throughout the river floodplain due to the systemic impacts of impoundment (sedimentation) may necessitate the use of shallower draft boats on the river.

Many forms of recreation common to the river require facilities such as boat ramps, trails, campgrounds, beaches, picnic areas, etc. The public demand for these facilities is going to grow and steps will be required to meet these demands.

Recreational use of the Upper Mississippi River is directly related to habitat quality, especially for such activities as hunting, fishing, and trapping. Declines in future habitat quality would likely result in a decline in opportunities for these forms of recreation.

PROBLEM AND OPPORTUNITY IDENTIFICATION

5.1 CHANNEL MAINTENANCE/NAVIGATION

5.1.1 CHANNEL MAINTENANCE

Tables 5-1 and 5-2 summarize information concerning existing dredge cuts in pool 3 and upper pool 4. The dredging locations for the period 1970 through 1995 are shown on plates 6 through 15. As can be seen from table 5-1, the most frequent dredging in pool 3 occurs in the lower reaches of the pool at the Coulter's Island and Diamond Bluff dredge cuts. Dredging is required in this area about once every three years and accounts for about 60 percent of the dredging required in the pool. Dredging has not been required at the Prescott, Truedale Slough, and Four-Mile Island dredge cuts since 1972. In contrast, in the 1990's, dredging has been required at the Coulters Island and Diamond Bluff dredge cuts 6 out of 10 years.

Table 5-1
Pool 3 Dredge Cuts (1970-99)

Cut	River Miles	Percentage Years Dredged	Ave Vol/ Job (cy)	Ave Vol/ Year (cy)
L. Approach to L/D 2	814.9 - 815.1	14	22,700	3,000
Prescott	810.3 - 811.7	3	45,400	1,500
Truedale Slough	807.9 - 808.6	3	26,600	900
Four-Mile Island	807.0 - 807.9	3	68,400	2,300
Big River	804.1 - 806.0	14	23,200	3,100
Morgans Coulee	802.2 - 802.9	10	27,500	2,800
Coulters Island	800.8 - 801.9	31	27,700	8,300
Diamond Bluff	798.8 - 800.4	31	44,200	13,200
				35,200

Table 5-2
Upper Pool 4 Dredge Cuts (1970-99)

Cut	River Miles	Percentage Years Dredged	Ave Vol/ Job (cy)	Ave Vol/ Year (cy)
Trenton	794.0 - 794.6	7	57,700	3,800
Cannon River	792.1 - 793.5	28	35,000	9,400
Red Wing Hwy Bridge	789.5 - 791.2	7	72,900	4,900
Head of Lake Pepin	785.2 - 785.4	3	11,500	400
				18,500

source: Channel Maintenance Management Plan (April 00)

Dredging requirements in upper pool 4 are generally centered in the area of the Cannon River dredge cut. The Trenton and Red Wing Highway Bridge dredge cuts have not been dredged since 1975 and 1972, respectively. The Head of Lake Pepin dredge cut was last dredged in 1990 and in 2000.

Dredging requirements in pools 3 and upper pool 4 are a function of the sediment transport and hydrodynamic regimes in the pools.

Temporal Trends – Table 5-3 shows that there is an upward trend in dredging for both pool 3 and upper pool 4, and the St. Paul District overall. However, the rate of increase in pool 3 and upper pool 4 exceeds the rate of increase for the district. Table 5-4 shows an analysis of the correlation between hydrology and dredging. This was done by dividing the average annual dredging by the average river discharge at Lock and Dam 3 for the five-year time periods. Although there is an upward trend in average discharge, the increase in dredging is not proportional to river discharge. Dredging over the last few years has been well above average, even though the hydrology has not been extreme. Figure 1 shows annual dredging for five-year time periods in pool 3 and upper pool 4 going back to 1941. (It should be noted that the period 1996 through 1999 includes 1998 when the channel was "cleaned out" in association with the unloading of the Corps Island containment site. The amount of additional channel dredging over and above what may have occurred normally in that year has not been separated out.) The extremely high rates of dredging in the 1940's were probably due to the destabilizing effects of lock and dam construction. The high rates of dredging that occurred in the 1960's and 70's resulted in an oversized channel and are one of the primary factors causing the low rates of dredging in the late 1970's and early 80's and the upward trend in dredging since. The conclusion is that dredging is increasing in pool 3 and will probably stabilize at a level higher than what has been typical over the last 20 years, most likely between 50,000 and 100,000 cubic yards (cy) per year.

Table 5-3
Ratio of Pool 3/Upper Pool 4 Dredging to Average Dredging District-Wide

Time Period	Pool 3/Upper 4 Dredging (cy/yr)	St. Paul District Dredging (cy/yr)	Ratio
1976-1980	0	499,000	0
1981-1985	0	851,000	0
1986-1990	17,000	654,000	.025
1991-1995	60,000	870,000	.069
1996-1999	85,000	1,035,000	.082

Table 5-4
Ratio of Pool 3/Upper Pool 4 Dredging to Average Annual Discharge at L/D 3

Time Period	Ave. Annual Dredging (cy/yr)	Average Discharge (cfs)	Ratio
1976-1980	0	15,600	0
1981-1985	0	24,200	0
1986-1990	17,000	16,800	1.0
1991-1995	60,000	26,600	2.2
1996-1999	85,000	24,300	3.5

Spatial Trends - Prior to the 1970's, dredging occurred throughout pool 3 and upper pool 4. Since this time, most of the dredging has occurred in the middle reach of pool 3 at the Coulter's Island and Diamond Bluff dredge cuts, and at the Cannon River dredge cut in upper pool 4. Figure 2 is a plot of dredging and main channel discharge (given as percent of the total discharge) by river mile. Main channel discharge is fairly high throughout the study reach. However, like in many other reaches of the St. Paul District, there is a strong correlation between the location of dredge cuts and decreases in main channel discharge. The three largest dredge cuts, Coulters Island, Below Diamond Bluff, and Cannon River all occur where the main channel discharge has dropped to 75 percent or lower. Other factors affecting dredging include structures such as the lower approach to Lock and Dam 2, and tributaries such as the Cannon River

Figure 1

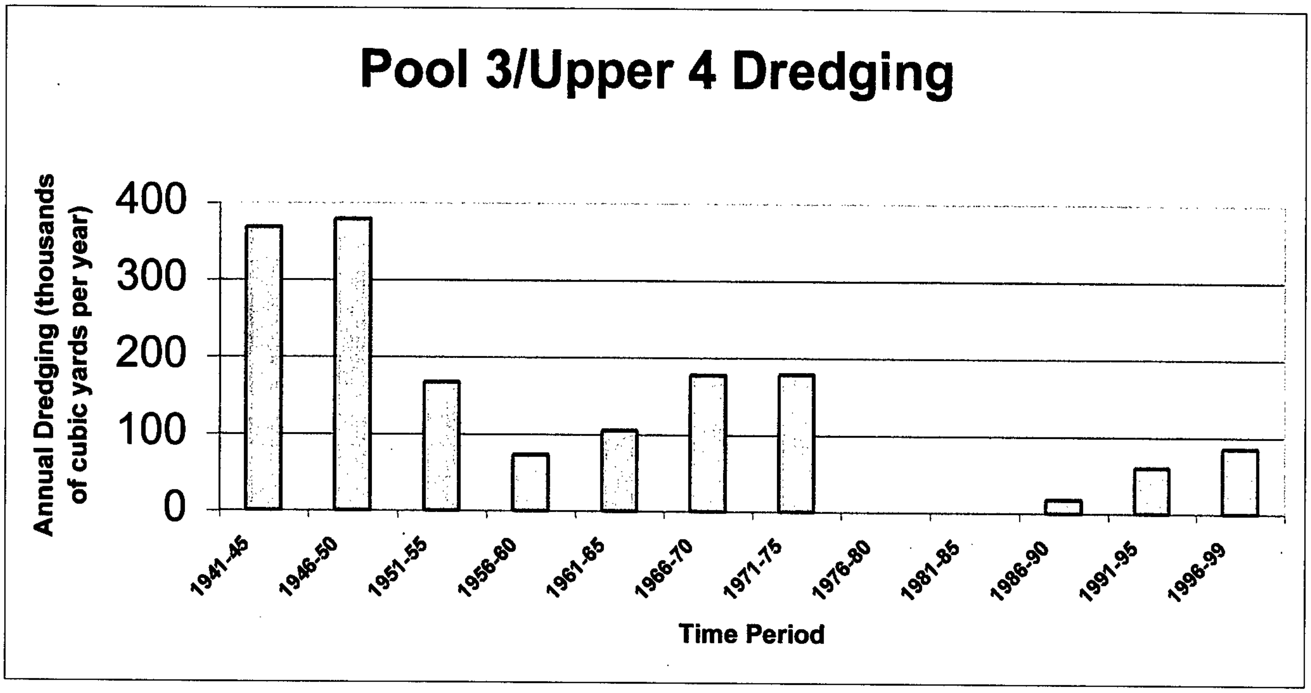
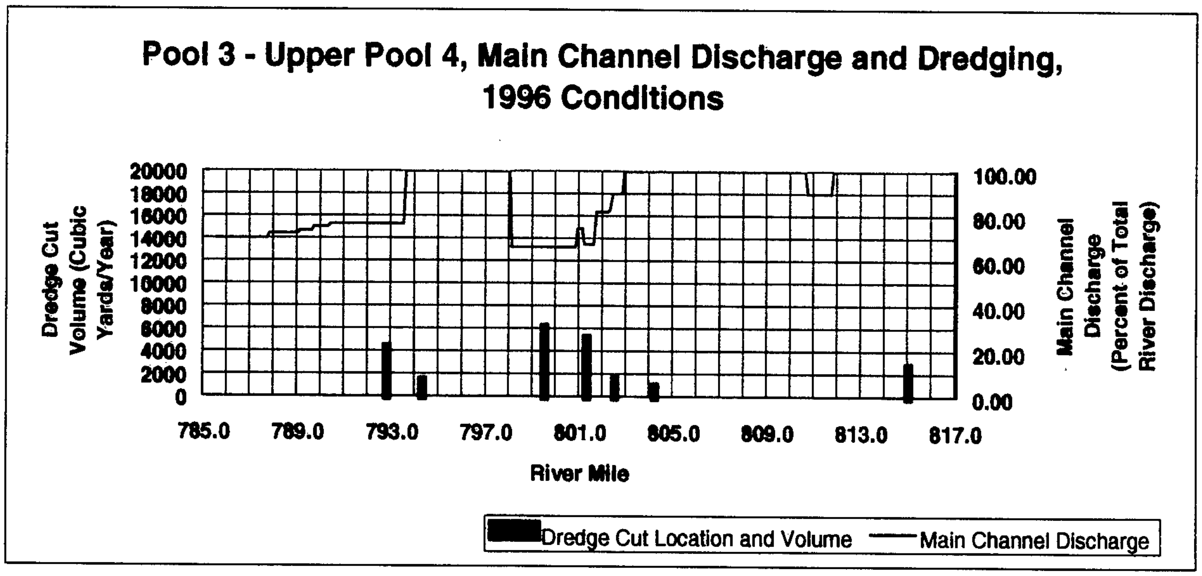


Figure 2



5.1.2 COULTER'S ISLAND AND MORGAN'S COULEE

After Diamond Bluff, the Coulters Island dredge cut is next in order of significance in terms of dredging frequencies and quantities in pool 3. The Morgans Coulee dredge cut is also a relatively important dredge cut located just above the Coulters Island cut. The dredged material from these two dredge cuts is designated for placement in the Corps Island site located at river mile 799.2, approximately 2.6 miles from most frequently dredged portion of the Coulters Island cut and 3.5 miles from the most frequently dredged portion of the Morgans Coulee cut. This requires the material to be mechanically dredged and placed at the Corps Island site at an approximate cost of $6.00/cy. The cost of hydraulic dredging and placement in this area is about $2.60/cy. Thus, if the Coulters Island/Morgans Coulee dredging requirements could be shifted to the Diamond Bluff area, the cost of channel maintenance in the lower pool 3 area would be reduced.

Temporal Trends – Two sets of discharge measurements for inlets to the North and Sturgeon Lake area were obtained in 1991 as part of study for the North and Sturgeon Lake HREPs. In late 1998 and early 1999, two more sets of discharge measurements were collected. Table 5-5 summarizes the relative size (based on percent of the total river discharge conveyed in 1998/99) and stability based on a comparison of 1991 to 1998/99 data. A 25-percent duration total river discharge of 28,500 cfs was used for reference. Based on the available data, it appears that the Brewers Lake Inlet has increased significantly in size, and that Jackson Run, Hardy Run, and the Sturgeon Lake Inlet have been stable. At higher flows all of these secondary channels convey water (e.g., 4.5% at Jackson Run when the discharge was up to 49,000 cfs). Flow into the Vermillion Bottoms is relatively low at this discharge. However, it does increase substantially for flood events.

Table 5-5
Secondary Channel Size and Stability, North and Sturgeon Lake Area

Site	River Mile	Discharge Percent	Stability
Truedale Slough	808.5	0.3	Unknown
Carter Slough	807.5	0.3	Erosion has occurred
Jackson Run	803.4	0	Stable; debris dam in 1991 and 1998
Miley Run	802.9	10.0	Insufficient data; debris dam in 1998
Hardy Run	802.2	0	Stable; debris dam in 1991 and 1998
Brewers Lake Inlet	801.7	14.5	Increased flow from 9% in 1991 to 14.5 % in 1998
Sturgeon Lake Inlet	800.9	8.2	Stable

5.1.3 LOWER APPROACH TO LOCK AND DAM 2

At Lock and Dam 2, currents from flow through the dam enter the navigation channel below the lower guide wall in a somewhat perpendicular manner. This lateral current entering the channel can affect the maneuverability of barge tows entering and leaving Lock and Dam 2.

5.1.4 LOCK WAITING SITES

Commercial tows at times have to wait for lockage. At present, there are no designated waiting areas for commercial tows below Lock and Dam 2 or at Lock and Dam 3. Generally, commercial tows "bump" up to the bank while waiting for lockage in whatever location in available. This has raised concerns that the tows on occasion tie up or hold their position in environmentally sensitive areas. Tows nudging into the bank and/or holding position can crush mussels and erode sediments with their prop wash. Tows tieing up to trees can kill the trees. In addition, because of the high levels of recreational craft use at Lock and Dam 3, the potential exists for conflicts or safety concerns between recreational and commercial users.

5.2 FISH AND WILDLIFE HABITAT

Fish and wildlife habitat problems and opportunities in pool 3 and upper pool 4 were identified in coordination with river resource management agencies and the public. Habitat problems can range from the systemic to the site specific. What is considered a habitat problem can depend on individual perspective and/or the public and personal values placed on the species using the habitat. In some instances, what is viewed as a site-specific problem may actually be a reflection of a long term, systemic change.

The impoundment of pool 3 created the unique situation where at normal pool conditions, water surface elevations in the Mississippi River are higher than in the Vermillion River. Water from pool 3 is prevented from flowing into the Vermillion River system by a series of low rock dikes ("spot dikes") across connecting channels and other low spots in the Mississippi River natural levee. The effects on the Vermillion River system during non-flood periods of this situation are minor because water surface elevations in the Vermillion River system are a function of conditions in upper pool 4 and runoff from the Vermillion River basin. Groundwater seepage from pool 3 is minor compared to surface runoff and other groundwater sources within the Vermillion River basin.

The effects of pool 3 on the Vermillion River bottoms during high water events are highly variable and complex, depending on the relative river stages in the two systems. Major flood events on the Mississippi River inundate both the Mississippi River floodplain and portions of the Vermillion River floodplain below Hastings, Minnesota.

The impoundment of pool 3 likely increased groundwater elevations adjacent to the pool though these relationships have not been investigated and are poorly understood. However, both the Vermillion and Mississippi River floodplains within the study area are surface water dominated systems, and it is likely that surface water conditions are the dominant factors affecting the fish and wildlife habitats.

5.2.1 BELOW LOCK AND DAM 2

Below Lock and Dam 2, on the left descending bank between river mile 814.3 and 814.8, is a shallow flat with water depths generally less than 2 feet. The fishery habitat value of this area is somewhat limited due to the shallow depths and lack of aquatic vegetation. The construction of an island or other structure in this area may stimulate the formation of a secondary channel through this flat, improving habitat diversity and quality.

5.2.2 CONLEY LAKE

Conley Lake is a backwater lake on the left descending bank of the river across from Hastings, Minnesota. Much of the lake is occupied by a large marina. This lake is relatively isolated from Mississippi River flows except during high water periods. Addition of flow to this backwater lake during low water periods may improve water quality conditions.

5.2.3 CARTER SLOUGH

A continuous connection has been formed from Carter Slough (river mile 807.3) to the Vermillion River via Mud Hen Lake and Round Lake. These lakes support excellent aquatic vegetation. The Minnesota DNR has expressed concern that this changed condition may eventually affect aquatic vegetation in these lakes, especially if this connection becomes larger and more flow passes through these lakes.

5.2.4 GOOSE LAKE/VERMILLION RIVER BOTTOMS

Goose Lake and several other area lakes in the Vermillion River bottoms lying landward of the Prairie Island area have poor habitat quality due to sedimentation and a lack of aquatic vegetation. A plan was developed under the UMRS-EMP habitat projects program in the early 1990's for the construction of water control structures and a pump station that would permit the periodic drawdown of the Vermillion River bottoms to promote increased plant growth. The project was never implemented due to conflicts with landowner uses around one of the lakes.

5.2.5 NORTH AND STURGEON LAKES

North and Sturgeon Lakes in the lower reaches of pool 3 are generally turbid with little aquatic vegetation. The opportunity exists to possibly improve fish and wildlife habitat conditions in these lakes.

5.2.6 DIAMOND ISLAND CHANNEL

Diamond Island is located on the right side of the navigation channel in upper pool 4 at river mile 795. At one time the main river channel passed behind Diamond Island, until navigation improvements resulting in cutting off this loop, making the channel behind Diamond Island a secondary channel. This channel at one time provided good fish habitat. Over the last decade or so, this secondary channel has shallowed due to sedimentation. It is believed this has been caused by a shifting of the outlet of the Cannon River. The loss of this secondary channel habitat is a concern because it is a relatively uncommon habitat type in the upper reaches of upper pool 4.

5.2.7 WISCONSIN CHANNEL

The Wisconsin Channel is a major secondary channel in upper pool 4, extending from river mile 793.5 to Lake Pepin. The Wisconsin Channel is considered a highly valuable resource, especially from a fishery perspective. Every opportunity should be taken to maintain this resource and prevent its degradation.

5.2.8 MUD LAKE AND DEAD SLOUGH LAKE

The lower portion of Mud Lake (below U.S. Highway 63) and Dead Slough Lake are shallow and turbid with little aquatic vegetation. The opportunity may exist to improve fish and wildlife habitat conditions in these lakes.

5.2.9 PIERCE COUNTY ISLANDS

The Pierce County Islands site is located on the Wisconsin side of the floodplain, immediately above Bay City, Wisconsin. At one time this area was managed for waterfowl and other wildlife by private interests. The dikes and water supply system fell into disrepair, and in the 1980's, this area was purchased by the Wisconsin DNR. The opportunity exists to restore the old dikes and water supply system to permit more intensive management of the area for waterfowl.

5.2.10 HEAD OF LAKE PEPIN

At about river mile 784, commercial tows leave Lake Pepin and enter the Mississippi River main channel. Navigation channel water depths in portions of this area are in the 12-14 foot range. The sediments in this area are relatively fine and it is believed that the navigation channel to some degree is kept open by the commercial tow traffic itself. The Corps of Engineers on occasion is required to dredge in this area, though the dredging is generally required because of point bar encroachment into the channel, not an overall shallowing of the channel.

Resuspension of contaminated fine-grained sediment is a concern as this may make these contaminants for available for bioaccumulation by river organisms. Concern has been expressed with the possible water quality effects of sediment resuspension by commercial tows.

5.3 RECREATION

5.3.1 INCREASED RECREATIONAL BOATING

Recreational boating in pool 3 and upper pool 4 has increased substantially in the last 10-20 years. This is the result of a number of factors, primarily increased population growth in the Twin Cities' metropolitan area and spillover from a heavily used lower St. Croix River. Lock and Dam 3 is the most heavily used lock and dam within the St. Paul District for recreational lockages. Recreational lockages account for about 65 percent of the lockages at Lock and Dam 3 on an annual basis. During summer weekends and holidays, the percentage increases significantly.

Increased recreational use places additional pressure on the resource base, and increases the potential for use conflicts and safety concerns. Study has shown that recreational boats are responsible for accelerated shoreline erosion and degraded water quality in the Red Wing area (Johnson, 1994).

5.3.2 BOATING HAZARDS

Channel control structures such as wing dams are submerged structures that can pose a hazard to recreational craft, especially if the boat operator is unfamiliar with the presence of these structures on the river.

5.3.3 TRENTON ISLAND MARINA

A marina is located on the inside bend of the main channel a short distance above the U.S. Hwy 63 bridge at Red Wing, Minnesota. This is a difficult bend for barge tows and the presence of this marina has created a potentially hazardous situation for the tows and recreational craft alike.

5.3.4 RECREATIONAL BEACHES

Beach-related recreational activities such as swimming, picnicking, and camping are popular on the islands and shorelines of the Upper Mississippi River. Demand for beach sites will continue to rise with increased boater use of pool 3 and upper pool 4. A recreation beach management plan has been developed by the Recreational Work Group and endorsed by the River Resources Forum. This plan outlines agency management actions to be taken to keep pace with public needs.

PROJECT GOALS AND OBJECTIVES

Goals and objectives for a resource such as the Upper Mississippi River can vary greatly depending upon perspective. Federal and State agencies have mandates and missions that require them to focus on particular aspects or uses of the resource. The public and users of the river all have their perspective on what the river should look like, and what functions or uses should receive priority for management.

It was recognized early in the study process that for a dynamic resource of the magnitude of the Mississippi River two types of goals are required, long-term and short-term. Long-term goals are more visionary and could be characterized as answering the question "What should the river look like 100 or 200 years from now?" Short-term goals address the planning horizon, i.e., the period 2001-2050. As a rule, short-term goals should support the long-term goals, or at the very least, not make accomplishment of long-term goals more difficult.

6.1 PROBLEMS/ISSUES OUTSIDE THE SCOPE OF STUDY

A number of resource problems and their causes have been identified for the study area, as noted in the previous section. Some of these problems were beyond the practical scope of this study effort to develop and implement solutions. In some instances the problems are being addressed as part of other studies. The more significant of these are discussed below. No goals and objectives were developed for problems/issues considered outside the scope of the study.

6.1.1 WATER LEVEL MANAGEMENT

Modification of the current method of navigation pool regulation has the potential to provide significant environmental benefits. However, evaluation of water level management alternatives is beyond the scope of this study. It is unknown to what degree water level management modifications may be implemented in either pool 3 or pool 4 over the next 50 years.

As noted earlier in this report, a preliminary water level management study has been conducted using pool 8 as the study pool. That study evaluated a variety of alternative water level management measures, the most significant of which were drawdown alternatives. Subsequent study has resulted in a recommendation to conduct a pilot drawdown in pool 8 during the summer of 2001. The results of that effort will need to be taken into consideration as part of the planning process for this study. The functioning of existing and modified channel structures under drawdown conditions will need to be considered during the evaluation of potential modifications.

6.1.2 LOCK AND DAM 3 EMBANKMENT PROJECT

Unlike other locks and dams within the St. Paul District, there was no large earthen dike constructed across the floodplain to maintain navigation pool 3. Instead, maintenance of pool 3 relies upon a series of low dikes ("spot dikes") along the Wisconsin and Minnesota shoreline upstream of the lock and dam. The integrity of the Wisconsin spot dikes is dependent upon the presence of two private dikes located just downstream of Lock and Dam 3. Over the years, the private dikes have deteriorated and there is concern with the long-term reliability of this dike system. The St. Paul District is currently evaluating options for insuring the long-term reliability of the dike system on the Wisconsin side of pool 3.

Whatever solution is eventually recommended for the Wisconsin spot dike system at Lock and Dam 3, it will have little bearing on management of the navigation channel in pool 3 and upper pool 4. During the execution of the Pool 3/Upper Pool 4 Channel Management Study, planners will need to remain cognizant of the Lock and Dam 3 embankment evaluations and actions that may be proposed as a result of those study efforts.

6.1.3 LOCK AND DAM 3 OUTDRAFT CONDITION

There is an outdraft problem at Lock and Dam 3 for downbound barge tows. The St. Paul District completed a safety study in 1995 (Corps of Engineers, 1995) which recommended construction of a guard wall extending approximately 1,230 feet upstream of the intermediate wall at Lock and Dam 3, and excavation along the right descending bank immediately above the upper guidewall. This project is currently being reevaluated as part of the Lock and Dam 3 embankment project.

6.1.4 FISH PASSAGE

The study, design, and construction of a fish passage structure at Lock and Dam 3 would require a specialized study with a depth of analysis and evaluation considered by the St. Paul District as beyond the scope of the District's Channel Management Program.

Installation of a fish passage structure at Lock and Dam 3 will be addressed if the embankment evaluation results in a recommendation for construction of a permanent embankment.

6.1.5 LOCK WAITING AREAS

Lock waiting areas are being addressed separately on a St. Paul District-wide basis to insure consistency in the design, implementation policy, and other factors from site to site. Therefore, there was no need to address this problem/issue as part of this study.

6.1.6 PIERCE COUNTY ISLANDS

The Pierce County Islands area is removed from the navigation channel and any present or future channel management activities will not have any effect on this area. Likely measures for wildlife habitat improvement at this site would include dike restoration and the development of water supply/control capabilities. The St. Paul District would not be able to participate in a project of this nature using 9-foot Navigation Channel project authorities. A habitat project at the Pierce County Islands could be pursued under Section 206 or UMRS-EMP authorities (see subsections 1.6.3 and 1.6.4, respectively). Because these other authorities are available, no evaluation for habitat improvement at the Pierce County Islands was pursued under this study.

6.1.7 GOOSE LAKE/VERMILLION RIVER BOTTOMS

Goose Lake and several other area lakes in the Vermillion River bottoms lying landward of the Prairie Island area have poor habitat quality due to sedimentation and a lack of aquatic vegetation. A plan was developed under the UMRS-EMP habitat projects program in the early 1990's for the construction of water control structures and a pump station that would permit the periodic drawdown of the Vermillion River bottoms to promote increased plant growth. The project was never implemented due to conflicts with landowner uses around one of the lakes.

The St. Paul District would not be able to participate in a project of this nature using 9-foot Navigation Channel project authorities. Reconsideration of the Goose Lake/Vermillion River Bottoms project could be pursued under Section 206 or UMRS-EMP authorities (see subsections 1.6.3 and 1.6.4, respectively). Because these other authorities are available for implementation of this project, it was not pursued under this study.

6.1.8 RECREATIONAL BEACH PLANNING/DEVELOPMENT

The St. Paul District, in cooperation with the Recreational Work Group of the River Resources Forum, has and is developing recreational beach management plans for the Upper Mississippi River. A plan has already been developed for pool 3 and upper pool 4. Because there already is a mechanism in place for the planning and development of recreational beach sites, there was no need to address this topic under this study.

6.1.9 TRENTON ISLAND MARINA

A marina is located on the inside of a bend in the main channel a short distance above the U.S. Hwy 63 bridge at Red Wing, Minnesota. This is a difficult bend for barge tows and the presence of this marina has created a potentially hazardous situation for the tows and recreational craft alike. If a hazardous condition does exist, it is outside the Corps of Engineers 9-Foot Navigation Channel project authority to rectify or ameliorate the situation. Navigation safety issues of this type are the purview of the U.S. Coast Guard and the State regulatory agencies responsible for boater safety, in this instance the respective Departments of Natural Resources.

6.2 UPPER MISSISSIPPI RIVER SUMMIT VISION

As noted earlier, identification of goals for the Mississippi River is not an easy task. Until very recently, it is unlikely that any systemic goal existed that was agreed to by a majority of Federal and State agencies, river users, and the public. However, in February 1996 the Upper Mississippi River Summit meeting was held, convening representatives of Federal and State agencies and river user groups to discuss a multi-interest strategy for managing the natural resources of the river. Most of the representatives attending that meeting agreed to a vision statement for the Upper Mississippi River as follows:

"To seek long-term compatibility of the economic use and ecological integrity of the Upper Mississippi River"

This vision statement has been expanded upon for this study to form the following long-term goal.

"Maintain, enhance, or restore the Mississippi River as a quality riverine ecosystem for all uses of the system, including fish and wildlife, commercial navigation, recreation, and riparian uses so that sustainable multiple use is achieved."

6.3 GOALS

The following goals were developed for the selected 50-year planning period in coordination with river resource management agencies. The goals are categorized by primary functional area.

6.3.1 CHANNEL MAINTENANCE/NAVIGATION

6.3.1.1 Channel Maintenance/Navigation Goal #1: Reduce channel maintenance dredging requirements in pool 3 and upper pool 4.

The basis for this goal is twofold. First, the Corps of Engineers, as managers of the 9-foot navigation channel project, has an obligation and responsibility to manage the project in as cost-effective manner as possible. Secondly, channel maintenance dredging has environmental effects, primarily associated with the placement of the dredged material. Reducing dredging requirements would reduce the both the cost and environmental effects associated with dredging and dredged material placement.

6.3.1.2 Channel Maintenance/Navigation Goal #2: Reduce the cost and environmental effects of channel maintenance dredging in pool 3 and upper pool 4.

Significant reductions of channel maintenance dredging in pool 3 and upper pool 4 may not be possible. Therefore, the goal is to accomplish required dredging in a manner that minimizes both costs and adverse environmental effects. One potential measure of accomplishing reductions in costs and environmental effects is to increase beneficial use of dredged material.

6.3.1.3 Channel Maintenance/Navigation Goal #3: Reduce or eliminate navigation safety hazards in pool 3 and upper pool 4 associated with channel conditions or channel structures.

Reducing or eliminating navigation hazards would reduce the potential for accidents and the associated potential for loss of life, property, and environmental degradation.

6.3.2 ENVIRONMENTAL

6.3.2.1 Environmental Goal #1: Restore and enhance natural river processes.

As noted earlier, a systemic fish and wildlife habitat problem on the Upper Mississippi River is the continued loss of habitat diversity. This is considered by the scientific community to be largely the result of the disruption of the annual hydrograph and the disruption of the hydraulic processes associated with an unimpounded or unconstrained river. Restoring, maintaining or enhancing these natural river processes should result in improved habitat conditions.

6.3.2.2 Environmental Goal #2: Restore and enhance habitat quality and diversity within the study area.

This goal is an extension of the previous goal. In many instances, the impoundment of the river by locks and dams and channel structures required for maintenance of the navigation channel may not allow the restoration of natural river processes as fully as desired. Other measures may be required to restore and enhance habitat quality and diversity in pool 3 and upper pool 4.

6.3.3 RECREATION

6.3.3.1 Recreation Goal #1: To protect, maintain and possibly enhance recreational beaches within the study area.

There are a number of popular recreation beach sites within the study area. Channel management actions should protect and/or enhance existing beach sites and the water access to them.

6.4 OBJECTIVES

Objectives are more specific than goals. They are designed to provide the link between specific problems and the broader goals. Study recommendations usually address objectives and contribute toward meeting goals. The objectives are also categorized by primary functional area. As with any multiple-use planning effort, it is recognized that there may not be 100 percent compatibility of the objectives across functional areas.

6.4.1 CHANNEL MAINTENANCE/NAVIGATION

6.4.1.1 Channel Maintenance/Navigation Objective #1: Reduce the lateral current problem that exists below the Lock and Dam 2 lower guide wall.

Reducing or eliminating the lateral current that enters the navigation channel just below the Lock and Dam 2 lower guide wall would reduce the potential for an accident in this area.

6.4.1.2 Channel Maintenance/Navigation Objective #2: Shift dredging requirements at the Coulters Island and Morgan Coulee dredge cuts downstream to the Diamond Bluff area.

Shifting dredging requirements downstream in this area would decrease the amount of dredged material that has to be mechanically dredged versus hydraulically dredged. This could reduce channel maintenance costs on average by about $3.40 per cubic yard.

6.4.2 ENVIRONMENTAL

Some of the environmental objectives are broadly defined and can be applied to the entire study area. Others are targeted toward specific areas of high resource value and concern.

6.4.2.1 Environmental Objective #1: Remove or modify channel control structures (wingdams, old shoreline revetment/protection, closing dams) which are no longer functional or needed for maintenance of the 9-foot navigation channel, and whose modification would substantially rejuvenate the scouring and depositional forces of the river.

Channel control structures are designed to concentrate flow in the navigation channel for the purpose of maintaining depths sufficient for commercial navigation. By their very nature, they are designed to control the natural fluvial processes of the river. All of the structures in the study area were constructed prior to the 9-Foot Navigation Channel Project. Due to the passage of time many have deteriorated. Modification or removal of these structures could contribute to improvements in habitat quality and diversity.

6.4.2.2 Environmental Objective #2: Maintain conditions in Mud Hen Lake and Round Lake suitable for the growth of aquatic vegetation.

As noted earlier, a continuous connection has been formed from Carter Slough (river mile 807.3) to the Vermillion River via Mud Hen Lake and Round Lake. These lakes support excellent aquatic vegetation. The Minnesota DNR has expressed concern that this changed condition may eventually affect aquatic vegetation in these lakes, especially if this connection becomes larger and more flow passes through these lakes.

6.4.2.3 Environmental Objective #3: Improve habitat conditions in North and Sturgeon Lakes.

North and Sturgeon Lakes are generally turbid with little aquatic vegetation. Habitat quality in these lakes is limited. Because of their large size, any measures that would improve habitat quality in these lakes would contribute substantially to the natural resource base in lower pool 3.

6.4.2.4 Environmental Objective #4: Restore secondary channel habitat behind Diamond Island.

The secondary channel behind Diamond Island has become degraded due to sediment deposition. Secondary channel habitat is relatively uncommon in the upper reaches of upper pool 4. Restoration of this habitat would be valuable to the overall quality and diversity of fish habitat in upper pool 4.

6.4.2.5 Environmental Objective #5: Maintain habitat quality in the Wisconsin Channel.

The Wisconsin Channel is a major secondary channel in upper pool 4 and is considered a highly valuable resource, especially from a fishery perspective. Maintaining this resource is considered to be of significant importance.

6.4.2.6 Environmental Objective #6: Improve habitat conditions in Lower Mud and Dead Slough Lakes

Lower Mud and Dead Slough Lakes are shallow and turbid with little aquatic vegetation. Habitat quality in these lakes is limited. Any measures that would improve habitat quality in these lakes would contribute to the natural resource base in upper pool 4.

6.4.2.7 Environmental Objective #7: Minimize the water quality effects of commercial tow traffic at the head of Lake Pepin.

There is transition at about river mile 785 where commercial tows leave Lake Pepin and enter the Mississippi River main channel. The sediments in this area are relatively fine and it is believed that the navigation channel to some degree is kept open by the commercial tow traffic

itself. The navigation channel in this area in not clearly defined and commercial tows can, to some degree, select their own passage into the Mississippi River main channel. Measures should be identified that would minimize the effects of commercial tow resuspension of fine sediments in this area.

6.4.3 RECREATION

6.4.3.1 Recreation Objective #1: Recognized beach sites within pool 3 and upper pool 4 should be considered for enhancement as an incidental benefit to this project.

While there is a mechanism in place for the planning and development of recreational beach sites within the study area, modification of channel control structures may effect boater access to these sites, either positively or negatively. The potential effects on recognized beach sites needs to be considered with any proposed modification of channel control structures or other channel management activity.

6.4.3.2 Recreation Objective #2: Channel control structures identified as acute hazards to recreational craft should be considered for modification.

Channel control structures (wing dams) by their very nature can pose a hazard to recreational craft, especially if the boat operator is unfamiliar with their presence. Any structure that is identified as an acute hazard should be considered for modification to reduce or eliminate the hazard.

PLANNING CONSTRAINTS

7.1 INSTITUTIONAL

7.1.1 CORPS OF ENGINEERS

Any channel management projects constructed under the authority of the 9-Foot Navigation Channel Project must have as its primary purpose maintenance of the navigation channel. Other purposes may be incorporated into the project to take advantage of planning opportunities or to mitigate adverse project impacts. However, features which have the sole purpose of enhancing non-navigation purposes cannot be constructed using project funds.

7.1.2 STATES

Proposed modifications to channel structures and/or other proposed actions are likely to fall, in some manner, under State regulatory purview. State regulatory requirements will need to be considered during the planning and design of any recommended actions.

7.2 ENGINEERING

No specific engineering constraints were identified.

7.3 ENVIRONMENTAL

Compliance with all applicable environmental laws and regulations will be required.

7.4 CULTURAL

No specific cultural resource constraints unique to the study area were identified. Compliance with all applicable cultural resource laws and regulations will be required.

7.5 SOCIOECONOMIC

The Prairie Island Sioux Tribal community is located in lower pool 3, generally lying between the navigation channel and the Vermillion River. Certain Federal lands in this area are reserved for their use. Proposed channel management measures were coordinated with the Tribal community.

FORMULATION/EVALUATION OF ALTERNATIVES AND PLAN SELECTION

Alternatives were formulated to address the problems, goals, and objectives identified in previous sections of this report. Based on screening processes and discussions with river resource management agencies, plan formulation focused on a number of distinct areas where problems or opportunities were identified. While alternatives were formulated and evaluated for these smaller areas, they were also evaluated for their overall contribution to meeting study area goals and objectives.

To facilitate ease of understanding, the alternatives are discussed from the head of the study area at Lock and Dam 2 down the lower end of the study area at Lake Pepin. Wing dam notching or other modifications for habitat purposes that cover the entire study reach are discussed following the pool 3 features and before the pool 4 features.

The No Action alternative was considered for each of the features evaluated.

8.1 LOWER APPROACH TO LOCK AND DAM 2

At Lock and Dam 2, currents from flow through the dam enter the navigation channel below the lower guard wall in a somewhat perpendicular manner. This lateral current entering the channel can affect the maneuverability of barge tows entering and leaving Lock and Dam 2. Designs were developed and evaluated to alleviate this problem.

8.1.1 DESIGN

The lateral current at the lower approach at Lock and Dam 2 can not be completely eliminated. However, it can be modified or moved so that it affects tows approaching Lock and Dam 2 further downstream when the tows are under more power, rather than when they under reduced power entering or leaving the lock chamber. Three designs were developed for analysis, all involving extending the lower guard wall of the riverward lock chamber. The designs analyzed were 600-foot and 1,600-foot guard wall extensions that would be emergent structures until river discharges reached 35,000 to 40,000 cfs; and a 700-foot guard wall extension that would be a submerged structure at all times. The structure evaluated under all three design options was a rock dike with a 10-foot top width and 1V:2.5H side slopes.

8.1.2 EVALUATION

8.1.2.1 Engineering

Hydraulic model studies indicated that the 600-foot long emergent rock dike option would best address the lateral current problem at L/D 2. The 700-foot long submersed dike option would not have enough of an effect, while the 1,600-foot emergent rock dike option would have too much of an effect.

The conceptual design for the 600-foot long emergent rock dike is a dike with a top width of 10 feet and side slopes of 1V:2.5H (plates 17 and 18). The top elevation of the dike would be 678.5, 3.5 feet above project pool elevation. Construction of the dike would require an estimated 18,500 cubic yards of rock.

8.1.2.2 Costs

The estimated cost of a 600-foot long emergent rock dike is $834,500 (table 8-1). At the current interest rate of 6 5/8 percent over a 50-year project life, the average annual cost would be about $57,650.

Table 8-1
Cost Estimate for a 600-Foot Rock Dike Extension of the Lower Guard Wall at Lock and Dam 2

Mob/Demob	$ 9,600
Rock	777,800
Construction Subtotal	$787,400
Plans and Specifications	$ 31,400
Construction Management	$ 15,700
Total Estimated Cost	$834,500

8.1.2.3 Environmental

Construction of the rock dike would not be expected to have any significant adverse effects on the environment. The dike itself would occupy between 1 and 2 acres of the river. The existing substrate would be covered with rock, which in turn would provide an alternative substrate for aquatic organisms. There would be localized changes in current patterns, none of which would be considered significant in the high-energy environment below the dam. Fish would probably relate to the structure provided by the dike and take advantage of the current breaks provided by the rocks.

Should this option be pursued further, natural resource management agencies have identified the following concerns that would need to be addressed.

a. A mussel survey of the effected area would be required.
b. Sediments should be tested for contaminants if dredging is required.
c. Changes in flow patterns in the tailwaters need to be considered.
d. A nearby bald eagle nest may require constraints on construction timing.

8.1.2.4 Other

At high river discharges, the rock dike would become submerged and would be considered a navigation hazard. This probably would require a marking buoy or use of some other mechanism to make lock users and recreational craft operators aware of its presence.

8.1.3 RECOMMENDATION

The engineering analysis conducted for this study was to a level of detail necessary to determine if there was a potential engineering solution to the lateral current problem below L/D 2. The analysis was not of sufficient detail to recommend implementation of a structural modification of this magnitude at L/D 2. Additional hydraulic modeling, foundations investigations, design, and safety analysis is required to insure the best engineering solution has been identified.

Additional environmental analysis is required to address the concerns noted above, as well as an analysis of whether the cost of a lower guard wall extension is justified by the safety benefits provided.

Therefore, it is recommended that the St. Paul District undertake, subject to resource capabilities and priorities, the additional investigations as may be necessary to develop a solution to the lateral current problem at the lower approach to Lock and Dam 2.

8.2 LOCK AND DAM 2 FLATS

Below Lock and Dam 2, on the left descending bank between river miles 814.3 and 814.8 is a shallow flat with water depths generally less than 2 feet. The fishery habitat value of this area is somewhat limited due to the shallow depths and lack of aquatic vegetation. The construction of an island or other structure in this area could improve habitat diversity.

8.2.1 DESIGN

An island was designed for the area below Lock and Dam 2 that would shelter the shallow flats from currents and increase habitat diversity in this area. The island would be approximately 1,700 feet long (plate 17) and about 140 feet wide. The top elevation would be 678.5, 3.5 feet above the project pool elevation of 675.0.

The island would be constructed primarily of sand, with a 1-foot layer of topsoil for vegetation growth. The island would be seeded with grasses, with willow plantings along the shoreline for stabilization purposes. Additional shoreline stabilization for the island would consist of 40-foot long rock vanes spaced at 100 foot intervals on the channel side of the island; a 200-foot long offshore rock mound (approximately 30 feet from the island shoreline) at the tip; and 30-foot long rock groins spaced at 180 foot intervals on the interior of the island.

One channel was designed the pass through the center of the island to provide some flow to the protected area behind the island. (The Minnesota DNR requested that if this project was ever pursued further, consideration be given to placing the channel along the left descending bank.) The channel through the island would be stabilized using 2 riffle-pool structures. Given the shallow water depths in this area, excavation would be required to place the riffle-pool structures.

The approximate material requirements for this island would be:

31,000 cubic yards of sand
6,300 cubic yards of fines (topsoil)
1,700 cubic yards of rock
4 acres seeding
3,400 willow shoots

If the channel were moved to the left descending bank, additional rock could be required to protect the shoreline.

8.2.2 EVALUATION

Construction of an island below Lock and Dam 2 could be pursued under a number of authorities, Section 204, Section 1135, Section 206, and UMRS-EMP, all of which are described earlier in this report (see Section 1.6). All of these authorities require a non-Federal sponsor to

share in project costs, though the requirements vary by authority. The evaluation for this study focused on whether or not construction of an island could be pursued under 9-Foot Navigation Channel project authorities, i.e., as the least cost environmentally acceptable method of dredged material placement.

The Lower Approach to L/D 2 dredge cut is located at river miles 814.9-815.1. This dredge cut was not dredged during the period 1975-88. However, since 1989, dredging has been required three times, 1989 (10,500 cy), 1992 (19,100 cy), and 1998 (29,100 cy). The currently designated placement sites for material from this dredge cut are two areas located on the right bank of the river just below Lock and Dam 2 and at the Hastings small boat harbor located about 2 miles down river. All of these sites are beneficial use stockpile sites. Material from the last three dredging events noted above was placed at the sites located below Lock and Dam 2, and it expected that material from future dredging will also go to these sites. Dredged material placement at these sites requires the use of mechanical dredging equipment which currently costs about $6.00/cy for dredging and placement. Island construction can be accomplished using hydraulic dredging, which normally is less costly than mechanical dredging. Therefore, the question becomes whether construction of the island would provide enough savings from the channel dredging to offset the costs for topsoil, rock, geotextile, seeding, and willow plantings.

The cost differential between hydraulic placement (island construction) and mechanical placement was estimated to be about $2.50 cy. Thus, construction of the island using 31,000 cy of channel sand would save about $77,500 in channel maintenance dredging costs. A preliminary cost evaluation (table 8-2) indicates that other costs associated with island construction would be over 2.5 times the estimated channel maintenance savings. Because of the large difference between the estimated savings and the preliminary estimate of additional costs, a more detailed cost analysis was not conducted.

Table 8-2
Preliminary Estimate of Island Costs
in Addition to Sand Placement

Fine material placement @ $12.00/cy	$ 75,000
Rock @ $50/cy	85,000
Seeding @ $2,000/acre	8,000
Willow plantings (job)	5,000
Construction subtotal	$173,000
Planning and Engineering (15%)	26,000
Supervision and Administration (10%)	17,000
Total Estimated Cost	$216,000

8.2.3 PLAN SELECTION

Because the cost of constructing the island would be significantly greater than the potential savings associated with hydraulic dredging and placement of the channel maintenance material, the selected plan relative to the St. Paul District's channel maintenance program is the no action plan. Channel maintenance dredged material from the Lower Approach to L/D 2 dredge cut will continue to be placed at the currently designated beneficial use placement sites.

This determination does not address the question of whether the habitat benefits of island construction below Lock and Dam 2 justify the costs. If a non-Federal party expresses an interest in constructing an island under one of the authorities listed in Section 1.6, the St. Paul District would be willing to pursue this further. Strictly from a cost perspective, it would be most advantageous for the non-Federal sponsor to use Section 204 authority, which only requires cost sharing for that portion of the project above and beyond the normal cost of channel maintenance. Based on coordination with resource management agencies concerning this feature, it appears very unlikely that a non-Federal sponsor will be forthcoming. The Minnesota DNR has indicated they would prefer to allow natural island forming processes to occur in this area and as such, are not interested in pursuing this project as a non-Federal sponsor.

8.3 CONLEY LAKE

As discussed previously in Section 5.2.2, introduction of flow could potentially improve water quality in this backwater lake. A review of historic aerial photographs (1927, 1940, and 1975) indicates Conley Lake has always been relatively isolated from the Mississippi River during non-flood periods (other than at its outlet). The creation of pool 3 in the 1930's raised water levels and increased the size of Conley Lake, but did not result in any direct permanent connection between the river and the lake during non-flood periods. A 1994 aerial photograph (plate 19) indicates that a connection may be forming via a route under the U.S. Highway 61 bridge and the railroad bridge. As an aside, the 1994 photograph is a color IR photo on which it is easier to distinguish water that may have been present but not distinguishable on the older black and white photos. However, it is readily evident on the older photos that no continuous channel existed between Conley Lake and the river (aside from the lake's outlet).

Excavation of a channel to introduce flow into Conley Lake would require excavation under the two bridges noted above and across about 1,000 feet of land. This area is currently a mixture of bottomland forest and marsh with a substantial amount of woody debris present. A gross cost estimate is that excavation of a channel through this area would likely cost between $50,000 and $100,000, assuming no unforeseen problems were encountered.

Construction of the channel would require obtaining concurrence from the parties responsible for the highway and railroad bridges, and as a minimum, concurrence from the private landowner. Some additional real estate interest could be required. Another concern would be long-term maintenance as it is evident from the woody debris already present that the area between the two bridges is a debris trap.

The St. Paul District has no authority to pursue this project using 9-foot Navigation Project authorities. While there are some basic questions concerning the feasibility or cost effectiveness of constructing such a channel, the District would be willing to look into the matter under Section 206 or UMRS-EMP authority if a non-Federal sponsor indicates an interest in pursuing this further.

8.4 CARTER SLOUGH

A continuous connection has been formed from Carter Slough (river mile 807.3) to the Vermillion River via Mud Hen Lake and Round Lake (plate 20). These lakes at one time supported excellent aquatic vegetation. Presently, much of the submerged plant community is gone and emergent vegetation is limited to a thinning and receding band along the fringe of the lakes. The Minnesota DNR has expressed concern that the changed conditions caused by the continuous connection may be responsible for the decline in vegetation because of the larger flows passing through these lakes.

Previous investigations had looked at the Carter Slough situation. In 1987, the St. Paul District contracted for investigations of the spot dike system used to maintain navigation pool 3. The study indicated that the Carter Slough spot dike was being bypassed in two locations. The consulting engineer recommended construction of two new spot dikes at these breakout points.

In 1990, the draft Definite Project Report for the Goose Lake Habitat Rehabilitation and Enhancement Project (HREP) recommended construction of a single new dike at the mouth of Carter Slough. The Goose Lake planning team determined that because of access concerns, it would be easier to construct a single dike at the mouth of Carter Slough versus the two dikes recommended by the consultant in 1987. The Goose Lake HREP was never implemented and the recommended dike at the mouth of Carter Slough was never constructed.

8.4.1 DESIGN

The design developed for this study was a modification of the recommended plan from the Goose Lake HREP. The design is shown on plate 21. The elevation of the dike was increased from 677.0 to 679.0 to provide additional control.

The Goose Lake HREP was designed to provide for water control in Goose Lake and other portions of the Vermilion River bottoms. Thus, the structure recommended in 1990 included a gated culvert. This feature was eliminated from the current design as the purpose of the spot dike is to keep Mississippi River flows from entering the Vermilion River bottoms during normal river stages. In addition, Minnesota Department of Natural Resource experiences in this area have shown that water level management is very difficult and having a gated culvert in a new Carter Slough spot dike would probably be a waste of money.

8.4.2 EVALUATION

8.4.1.1 Costs

The estimated cost of the new Carter Slough spot dike is $86,500 (table 8-3). The detailed cost estimate is contained in appendix B.

Table 8-3
Cost Estimate for Carter Slough Spot Dike

Mob/Demob	$ 9,600
Snagging	9,600
Access Dredging	38,300
Stripping	500
Geotextile	700
Rock	18,100
Construction Subtotal	$76,800
Plans and Specifications	$ 6,500
Construction Management	$ 3,200
Total Estimated Cost	$86,500

8.4.1.2 Benefits

The existing Carter Slough spot dike is part of the spot dike system used to maintain navigation pool 3. The need for repairs due to bypass flows was identified in 1987. Repairs have not been pursued because the bypass flows have not as of yet become a significant problem and due to other higher priorities for St. Paul District operation and maintenance resources. Construction of the new Carter Slough spot dike at this time would obviate the need to undertake repairs at this location at some time in the future.

Construction of the new spot dike and elimination of the bypass flows would eliminate the habitat degradation these flows are causing in Mud Hen Lake. These habitat benefits are not quantifiable without substantial additional study that does not appear warranted given the level of investment required for the structure.

8.4.3 PLAN SELECTION

From the perspective of maintaining the integrity of navigation pool 3, it is not a matter of whether or not the Carter Slough spot dike will need to be repaired, but when. Eventually the bypass flows will reach a point where repair will be necessary. Construction of the new spot dike sooner than later will eliminate the habitat degradation in Mud Hen Lake that would occur in the interim. Therefore, it is recommended that the new spot dike be constructed as soon as operation and maintenance resources allow.

8.5 FOUR-MILE ISLAND

At river mile 807.3 a point bar extends out from the right side of the channel, narrowing and creating a bend in the navigation channel. This area has not been a significant channel maintenance problem, last requiring dredging in 1972. Measures were looked at to reduce the size of the point bar and make the bend in the channel less severe for commercial tows navigating this reach. Reducing the point bar would also probably minimize the potential for future channel maintenance requirements at this site.

8.5.1 DESIGN

The approach used was to increase flow in the main channel in this location by reducing the amount of flow passing down a side channel flowing behind an island chain on the right bank of the main channel extending from river mile 808.2 down to river mile 807.35. It appears that this island chain was created by accretion of sediments atop a wing dam field, as there are five wing dams crossing the side channel behind the island. Measures designed to reduce flows down the side channel included restoration of wing dams 807.4R, 807.6R, and 807.8R, and construction of a closure structure at river mile 807.8 to close a gap in the island chain.

The restoration of the wing dams would be done in a manner to concentrate flows where they pass over the wing dams to induce scour in the side channel to increase bathymetric diversity and obtain secondary fish habitat benefits. The particular reach of the side channel where the wing dam restoration would take place currently is relatively shallow with uniform or gradually changing bathymetry.

8.5.2 EVALUATION

Hydraulic modeling indicated that the design would provide only minimal benefits to the navigation channel. Based on these results, no further engineering and cost analysis work was conducted. The modification of the wing dams behind the island for habitat purposes was considered under wing dam notching (see Section 8.9).

8.5.3 PLAN SELECTION

The selected plan is the no action alternative.

8.6 BIG RIVER

At river miles 805.0-805.5 the navigation channel makes a bend, the navigation of which is made difficult by sediment accretion on the right descending side of the channel. In the Channel Maintenance Management Plan this site is labeled the Big River dredge cut, though in some instances it has been referred to as the Smith Bar Upper Light dredge cut. This area was dredged 6 times in the 1950's, twice in the 1960's, in 1972, in 1989, and twice in the 1990's (1993 and 1995). Measures were evaluated to reduce sediment accretion in this reach to improve the navigability of this bend and possibly reduce dredging requirements.

8.6.1 DESIGN

Constriction of main channel flows was considered the option with the most potential for increasing depths and reducing dredging requirements at this location. Constriction of the channel could be accomplished by restoring 4 to 6 wing dams in this reach. This includes 4 wing dams on the left bank at river miles 804.9, 805.1, 805.2, and 805.25, and two wing dams on the right bank at river miles 805.3 and 805.5 (plate 22).

8.6.2 EVALUATION

8.6.2.1 Engineering

Hydraulic modeling was used to evaluate the effectiveness of restoring the following three combinations of the wing dams:

Option 1	804.9	805.1	805.2	805.25	
Option 2	804.9	805.1	805.2	805.3	805.5
Option 3	805.1	805.2	805.25	805.3	

The model results indicated that option 1 would be the most effective in achieving the desired changes in the navigation channel. Therefore, this option was analyzed further.

Under option 1, the four wing dams would be restored to elevation 671.0, four feet below project pool elevation (plate 23). The wing dams would not be restored beyond their original length. Wing dams 805.1 and 805.2 would be notched to encourage the formation of scour holes to improve local fish habitat diversity. The following would be the material and other quantity requirements associated with the restoration of these four wing dams.

	804.9	805.1	805.2	805.25
stripping (cy)	5	8	7	6
geotextile (sf)	982	1,210	1,186	923
rock (cy)	326	228	246	255
notch excavation (cy)	-	27	6	-

8.6.2.2 Costs

The estimated cost of restoring the four wing dams is approximately $67,000 as shown in table 8-4. The detailed cost estimate is contained in appendix B. Assuming a 50-year project life for the restored wing dams, the average annual cost at the current interest rate of 6 5/8 percent would be $4,640.

Table 8-4
Cost Estimate for Big River Wing Dam Restoration

Mob/Demob		$ 9,600
Stripping		800
Geotextile		1,800
Rock		46,200
Notch Excavation		500
	Construction Subtotal	$58,900
	Plans and Specifications	$ 5,500
	Construction Management	$ 2,800
	Total Estimated Cost	$67,200

8.6.2.3 Environmental

Aside from the minor temporary disturbances associated with construction, the environmental effects of restoring these four wing dams would be expected to be negligible. The notching of wing dams 805.1 and 805.2 for fish habitat purposes would provide some localized improvements in bathymetric diversity.

8.6.3 PLAN SELECTION

The benefits of restoring the four wing dams would primarily be associated with making the navigation channel in this reach somewhat safer and more navigable. It is not possible to quantify this benefit. Conducting a risk analysis assessment to the depth of detail necessary to provide meaningful results would likely cost as much as the wing dam restoration itself.

There may also be a small reduction in dredging requirements at the Big River dredge cut over the long term. The average annual dredging volume at this cut is about 3,200 cubic yards. Reducing long term dredging requirements by 10% in this location would reduce average annual dredging costs by about $2,000.

The determining factor in making a decision whether or not to proceed with restoration of the four wing dams is the relatively low cost of the project and the lack of any associated adverse effects. The average annual cost of the investment would be about $4,640. Some of this cost is likely to be offset by minor reductions in long term dredging requirements. The remaining annual costs of $2,000 to $3,000 appear to be a worthwhile investment in improving the navigability of the channel in this reach. If one accident were prevented over the next 50 years, the investment would be considered money well spent. Therefore, the selected plan is to restore wing dams 804.9, 805.1, 805.2, and 805.25.

8.7 COULTERS ISLAND AND MORGAN COULEE

After Diamond Bluff, the Coulters Island dredge cut is next in order of significance in pool 3 in terms of dredging requirements. The Morgans Coulee dredge cut is also a relatively important dredge cut located just above the Coulters Island cut. The dredged material from these two dredge cuts is designated for placement in the Corps Island site located at river mile 799.2, approximately 2.6 miles from most frequently dredged portion of the Coulters Island cut and 3.5 miles from the most frequently dredged portion of the Morgans Coulee cut. This requires the material to be mechanically dredged and placed at the Corps Island site at an approximate cost of $6.00/cy. The cost of hydraulic dredging and placement in this area is about $4.00/cy. Thus, if the Coulters Island/Morgans Coulee dredging requirements could be shifted to the Diamond Bluff area, the cost of channel maintenance in the lower pool 3 area would be reduced.

8.7.1 DESIGN

The primary method investigated for accomplishing a shift in dredging requirements is to increase flows in the navigation channel in the Coulters Island/Morgans Coulee reach. The only way this can be accomplished is to reduce flows exiting the main channel in this reach. Three features were designed and evaluated to accomplish this goal (plates 24, 25, and 26). They were

a) a partial closure structure at the Brewers Lake inlet at river mile 801.7R

b) riffle structures (or channel liners) in Miley Run at river mile 802.9R

c) a partial closure at the upstream entrance to the channel passing behind Coulters Island (river mile 802.3L).

8.7.2 EVALUATION

8.7.2.1 Engineering

Hydraulic modeling indicates that construction of the above features would increase channel velocities and reduce dredging requirements at the Coulters Island dredge cut (see appendix C – Hydraulics Appendix). It is estimated that about 50 percent of the dredging requirements at the Coulters Island dredge cut would be shifted to the Diamond Bluff area.

The following would be the material and other quantity requirements associated with construction of these features.

	Miley Run Sills	Brewer Lake Closure	Coulters Island Closure
riprap	1,387 cy	6,906 cy	2, 496 cy
geotexile	901 sy	74 sy	278 sy
stripping	32 cy	16 cy	13 cy

8.7.2.2 Costs

A preliminary cost estimate was made for the purpose of determining the approximate cost of the above features (table 8-5).

Table 8-5
Preliminary Cost Estimate for the Coulters Island Reach Features

Mob/Demob	$ 10,000
Access Dredging	5,000
Stripping	1,000
Riprap	380,000
Geotextile	4,000
Construction Subtotal	$400,000
Plans and Specifications	$ 40,000
Construction Management	$ 10,000
Total Cost	$450,000

8.7.2.3 Benefits

A present worth analysis was conducted to determine what level of investment (cost of constructing the features) would be justified by various levels of reduction in future dredging costs. The analysis assumed that all of the material not dredged in the Coulters Island reach due to increased channel efficiencies would need to be dredged in the Diamond Bluff area. Different efficiencies were assumed for the Coulters Island features. Different assumptions were made concerning future increases in dredging requirements if these side channels are not stabilized and additional flow is lost from the main channel.

Table 8-6 shows the results of the analysis. The values in the table are the approximate construction costs for the Coulters Island features that would be considered break-even costs depending upon the assumptions made. For example, if it is assumed that the features would be 50% effective in shifting dredging requirements and that dredging requirements would increase by 5 percent/decade if the side channels are not stabilized, then the break even construction cost would be about $230,000.

Table 8-6
Results of Present Worth Analysis
Break Even Construction Costs for Coulters Island Reach Features

	No Increase in Future Dredging Requirements	5%/Decade Increase in Future Dredging Requirements	10%/Decade Increase in Future Dredging Requirements
30% efficient	$100,000	$160,000	$230,000
40% efficient	$135,000	$195,000	$260,000
50% efficient	$165,000	$230,000	$295,000
60% efficient	$200,000	$265,000	$330,000
70% efficient	$230,000	$295,000	$360,000

8.7.2.3 Environmental

By design, the three proposed features would decrease flows through their secondary channels, thus altering sedimentation in the North and Sturgeon Lake areas. Reducing flow would reduce bedload input and the resulting potential delta growth and shallowing of these lakes. However, residence times would be increased and the amount of suspended load settling in the deeper water areas of the Lakes may increase. The overall effect on sedimentation patterns in North and Sturgeon Lakes would be a slowing of the succession to terrestrial habitat. The increased residence time could also affect algae production, impacting water clarity. This flow reduction may also result in lower dissolved oxygen levels during winter, but is not likely to result in fish kills.

These side channel modification structures would cover existing benthic habitat and organisms; however, they would provide new habitat in the form of coarse rock and scour holes. The most increase in substrate and bathymetric diversity would be in Miley Run, where the riffle structures would create a small riffle-pool complex. The narrow channel connecting North and Sturgeon Lakes is considered high quality mussel and fish habitat. Altering flows with the side channel modifications could affect this habitat.

Reducing dredging requirements in the main channel may have some benefit to the aquatic organisms in this habitat; however, this benefit would be minimal due to the low habitat diversity and the high level of disturbance there caused by commercial and recreational traffic. If the side-channel modifications are pursued, there might be some controversy. Some resource managers and factions of the public view altering flow in secondary channels as being "un-natural" and further "channelizing" the river.

8.7.3 PLAN SELECTION

The present worth cost analysis indicates that it would not be cost effective spend \$450,000 to construct features that would shift about 50% of the Coulters Island dredging requirements to Diamond Bluff where dredging is less costly. The analysis indicates that even if it were assumed that the features would 70% efficient and there would be a 10% per decade increase in future dredging requirements without a project, construction of the features would not be cost effective.

No options were identified that would reduce costs without reducing efficiency, i.e., constructing smaller structures to reduce costs would also make them less efficient.

There are environmental concerns associated with the features that were evaluated. Because these features can not be justified from a cost perspective, the environmental concerns and/or measures to reduce these concerns were not assessed in detail.

The selected plan at this time is the no action alternative. If future dredging requirements in the Coulters Island reach increase substantially, the cost effectiveness of these measures should be reevaluated.

8.8 NORTH AND STURGEON LAKES

North and Sturgeon Lakes in the lower reaches of pool 3 are generally turbid with little aquatic vegetation. The opportunity exists to possibly improve fish and wildlife habitat conditions in these lakes.

8.8.1 ALTERNATIVES

The following alternatives were identified as having the potential for improving fish and wildlife habitat in North and Sturgeon Lakes.

8.8.1.1 Island Construction

Island construction in these lakes could benefit habitat conditions in a number of ways. First, the islands and the shallow areas adjacent to the islands would provide increased habitat diversity in the relatively monotypic open-water portions of the lakes. Secondly, the islands could be designed to break up the large wind fetches that exist in these lakes, providing shadow zones with reduced wind and wave-induced resuspension of sediments. This in turn should improve water transparency and increased aquatic plant production.

8.8.1.2 Pool Drawdown

Regulation of pool 3 creates a minimum water surface elevation (674.0 at the dam, 675.0 at Prescott, WI), below which the pool is not allowed to decline. This prevents the sediment consolidation and emergent aquatic plant regeneration that occurs in riverine backwaters during low water periods. Partial drawdowns of pool 3 would have the potential for substantial habitat benefit in North and Sturgeon Lakes, and in the other lakes and backwaters north of North Lake. As indicated earlier in this report (section 6.1.1), it is beyond the scope of this study to evaluate modifications to pool regulation. Therefore, beyond identifying that water level management (pool drawdown) has the potential for substantial habitat benefit in lower pool 3, no further evaluation of this alternative was conducted.

8.8.2 EVALUATION

As with the Lock and Dam 2 flats area (see Section 8.2), construction of islands in North and Sturgeon Lakes for habitat restoration could be pursued under a number of authorities. The evaluation for this study focused on whether or not islands could be constructed using 9-Foot Navigation project authorities.

An economic analysis was conducted to determine if island construction would be a feasible alternative method of dredged material placement vs. placing the material in Corps Island. The following assumptions were used, based on the dredging history in this area from 1986 through 1997.

a. The cost of mechanical dredging for the Coulters Island dredge cut is $6.00/cy. The average dredging job for the period 1986-97 was about 18,000 cy.

b. The cost of hydraulic dredging for the Diamond Bluff dredge cut is $4.00/cy. The average dredging job for the period 1986-97 was about 21,000 cy.

c. Corps Island has a remaining capacity of about 466,000 cy, good for about 20 years of dredging from the Morgans Coulee, Coulters Island, and Diamond Bluff dredge cuts (ave. annual cumulative quantity of about 24,000 cy/yr).

d. Constructing a small island (~ 20,000 cy or 12.3 acre-feet) with material from a dredging event at Coulters Island or Diamond Bluff would extend the useful life of Corps Island about 1 year.

e. Unloading Corps Island would cost about $1.7 million, the average of the two bids received on the last unloading contract.

The analysis indicates that the break-even point (cost of island construction vs. the cost of normal channel maintenance practices) is about $115,000 for the Diamond Bluff dredge cut and about $140,000 for the Coulters Island dredge cut. An estimated cost of about $4.50/cy for sand placement for island construction leaves $25-50,000 for other costs such as stabilization, topsoil, and seeding.

It appears that island construction using channel maintenance material could be pursued under channel maintenance authorities if costs for stabilization and other requirements were minimized. This would require taking some risks that would need to be balanced against the potential habitat benefits.

8.8.3 PLAN SELECTION

No long-term plans for fish and wildlife restoration and enhancement have been developed for North and Sturgeon Lakes. The Fish and Wildlife Work Group (FWWG) of the River Resources Forum is currently developing long term desired future habitat condition plans for the navigation pools in the St. Paul District. It is expected that the pool 3 plan will be substantially complete by the end of 2001.

The selected plan is to defer any further consideration of island restoration in North and Sturgeon Lakes until the completion of the FWWG planning effort. If the long term plan for the lakes is to restore islands in the lakes, the river resource management agencies, the Prairie Island Indian Community, the Corps of Engineers, and the public will need to determine the best avenue for implementing the plan. This could include the use of channel maintenance material for any recommended island construction.

8.9 WING DAM NOTCHING

All of the wing dams in the study area were evaluated to determine if notching would improve localized bathymetric diversity and fish habitat values. Following this screening process 21 structures were identified for more detailed evaluation. Two of the wing dams would be notched as part of the wing dam restoration at Big River (see Section 8.6), while a portion of third is recommended for removal as part of a wing dam removal proposal (see Section 8.10).

8.9.1 DESIGN

The basic design is a notch in the wing dam, generally ranging from 10 to 50 feet wide, depending upon the situation. The depth of the notches would vary depending upon the surrounding bathymetry, usually are in the 5-8 foot range. The locations of the potential notches are shown on plates 27 through 33.

The material excavated from the notches can be used to create additional habitat structure in the area of the notch, used for bank stabilization, or taken to an upland placement site. Generally, it is most cost effective to use the material at the site to create additional habitat structure or for bank stabilization.

8.9.2 EVALUATION

8.9.2.1 Costs

Table 8-7 summarizes the estimated costs for the 18 wing dams under consideration. A more detailed estimate is contained in appendix B.

Table 8-7
Cost Estimate for Wing Dam Notching

Mob/demob	$ 9,600
Wing Dam 809.4R	3,600
Wing Dam 809.3R	2,400
Wing Dam 807.8R	4,900
Wing Dam 807.6R	400
Wing Dam 807.4R	1,500
Wing Dam 807.3R	1,100
Wing Dam 806.1L	3,500
Wing Dam 801.7L	2,300
Wing Dam 801.6L	900
Wing Dam 801.4L	5,600
Wing Dam 800.6R	2,100
Wing Dam 800.4R	1,200
Wing Dam 800.3R	1,700
Wing Dam 800.0L	900
Wing Dam 799.8L	900
Wing Dam 799.7L	900
Wing Dam 797.6L	3,100
Wing Dam 797.5L	3,500
Construction Subtotal	$50,100
Plans and Specifications	$ 4,900
Construction Management	$ 2,400
Total Cost	$57,400

8.9.2.2 Habitat Benefits

The main channel border habitats in the area of the wing dams proposed for notching consist of relatively shallow sand flats with little bathymetric diversity. Furthermore, four of these structures (807.8R, 807.6R, 807.4R, 807.3R) restrict flow in a secondary channel, thereby promoting sediment deposition. Notching wing dams is intended to improve aquatic habitat by increasing bathymetric and current velocity diversity, and by increasing flow in secondary channels where applicable. Also, placement of the coarse notch material will create additional habitat in the area as cover for aquatic organisms.

It is difficult, however, to predict how successful wing dam notching will be in enhancing bathymetric diversity and restoring secondary channels. The smallmouth bass habitat model was used to estimate changes in habitat values (appendix E). The assumptions used in the

smallmouth bass habitat model are listed in the habitat evaluation narrative in appendix E.

Average annual costs per structure (including equal portions of mob/demob, plans and specifications, and construction management) (50-year project life) ranged from \$124 to \$791. The average annual costs per habitat unit were estimated to range from \$178 to \$1,654. These estimated average annual habitat costs compare favorably to those considered justified under the UMRS-EMP habitat projects program where costs up to \$1,500 per habitat unit are common, and where in some instances, costs up to \$3000 per habitat unit have been considered justified.

8.9.3 PLAN SELECTION

Wing dam notching will provide habitat benefits at costs considered justified for the types of benefits provided. The overall estimated cost for notching the 18 wing dams (\$57,400) is relatively minor. Therefore, the selected plan is to notch the 18 wing dams listed in table 8-7.

8.10 WING DAM REMOVAL

The Minnesota DNR suggested considering leveling some wing dams to create an area with a rock or rubble substrate in the main channel border. Structures identified for consideration were those along the right descending bank between river miles 807.3 and 807.9, between river miles 808.4 and 808.7, and between river miles 809.3 and 810.0.

8.10.1 EVALUATION

Because of concerns with marginal channel conditions in the Four Mile Island reach (see Section 8.5), it was not considered advisable to pursue wing dam removal along the right descending bank between river miles 807.3 and 807.9 for fear of worsening conditions for navigation in this reach. Removal of wing dams in the 808.4 to 808.7 reach would have less navigation concerns, though the situation would need more detailed evaluation re: would removal of these wing dams cause the point bar on the Wisconsin side of the channel to grow? Growth of this point bar could create a dredging and/or a navigation problem in this area.

Of the seven wing dams located between river miles 809.3 and 810.0, the upper three were considered too small and inconsequential to provide a test of wing dam removal as a method of habitat restoration. The lower two wing dams (809.3 and 809.4) are nearly buried by sand, not an optimum situation to test wing dam removal. Of the remaining two wing dams, 809.5 and 809.7, the upper one has good bathymetric diversity around it, which would suggest it provides relatively good fish habitat. It is questionable whether the habitat created by removing this wing dam would be an improvement over the existing condition from a fish habitat perspective.

This left wing dam 809.5 as the best candidate in this reach upon which to try removal as a restoration technique. The shore end of the wing dam is somewhat buried in sand, while the channel end sticks out in relatively deep water where leveling would be difficult. Focus was placed on the center of the wing dam where the rock removed could be spread on the upstream side to create an area of rubble substrate.

The estimated cost of removing a 100-foot section of wing dam 809.5 down to elevation 670.0 would be approximately $10,100. The habitat benefits were evaluated in a manner similar to the wing dam notches (appendix E). The estimated cost of the habitat benefits to be achieved are about $670/AAHU which are considered within the range of justifiable costs for the type of habitat benefits that would be provided.

8.10.2 RECOMMENDATION

The recommendation is to remove 100 feet of the center of wing dam 809.5 with the material removed placed in about a 1-foot thick layer upstream of the notch. An estimated 380 cubic yards of material would be removed which would cover about .25 acre of river bottom with rubble. The section that would be removed would be centered on the notch symbol on plate 27.

8.11 DIAMOND ISLAND

Diamond Island is located on the right side of the navigation channel in upper pool 4 at river mile 795 (plate 34). At one time the main river channel passed behind Diamond Island, until navigation improvements resulting in cutting off this loop, making the channel behind Diamond Island a secondary channel. This channel historically provided good fish habitat. Over the last decade or so, the channel behind the island has become shallower due to sedimentation. It is believed that this has been caused by a shift in the outlet of the Cannon River. The degradation of this secondary channel habitat is a concern because it is a relatively uncommon habitat type in the upper reaches of upper pool 4.

8.11.1 DESIGN

A conceptual design was developed that includes construction of a closure structure at the upstream end of the secondary channel behind Diamond Island and vanes for erosion protection within the channel (plate 35). The purpose of the closure structure is to force the Cannon and Vermillion Rivers to flow the entire length of the Diamond Island secondary channel and enter the Mississippi River at river mile 794.8. During high flow events on the Mississippi River, a significant amount of water will flow over the closure structure. Since this water is from the top of the water column, it will have a lower sediment load than what currently enters the secondary channel. A stable channel should eventually be formed by the Cannon and Vermillion Rivers.

Nine vanes approximately 100 feet apart should be constructed along the outside bend of the Diamond Island secondary channel to prevent bank erosion. The elevations of the vanes would be 670.0 at the riverbank, and 667.0 at the end. The vanes would be effective during high flow events on the Cannon and Vermillion Rivers that occur when discharge is below average on the Mississippi River. The vanes were included in the design to address concerns with potential bank erosion and break-out flows expressed by the owner of the adjacent property on the left descending bank of the back channel, the Red Wing Wildlife Protection League. Construction of the project without the vanes would be an option. Monitoring would be required to determine if the project was having any effect on bank erosion.

An option identified for consideration by the Minnesota DNR was to notch the old closing dam in the lower reaches of the channel and use the material to construct a low (elevation 669.0), notched closing dam at the head of the Diamond Island channel. A hydraulic engineering review of this proposal indicates that notching the closing dam and constructing a closing dam to elevation 669.0 would be insufficient to generate the type of changes desired. The design philosophy of the closing dam is keep the Mississippi River out much of the time and allow the Cannon/Vermillion River flows to affect the geomorphic change in the back channel. If anything, the design elevation (672.0) of the closure designed for evaluation is somewhat on the low side because the 1.5-year flood event has an elevation of about 675.0 in this reach. A closure structure with a top elevation of 669.0 just would not have much of an effect on hydraulic and geomorphic conditions.

8.11.2 EVALUATION

8.12.2.1 Costs

The estimated cost of the design developed for Diamond Island is $346,000 (table 8-8).

Table 8-8
Cost Estimate for Diamond Island Secondary Channel Restoration

Diamond Island Closure	
Mob/demob	$ 9,600
Stripping	900
Geotextile	2,000
Rock	159,700
Subtotal	$172,200
Secondary Channel Vanes	
Access dredging	$119,900
Rock	8,300
Subtotal	$128,200
Construction Subtotal	$300,400
Plans and Specifications	$ 29,800
Construction Management	$ 14,900
Total Estimated Cost	$345,100

Construction of the project without the vanes would reduce project costs to about $200,000.

8.12.2.2 Environmental

Restoring flow to the Diamond Island secondary channel would improve the lotic habitat in that reach. This in turn would provide habitat for native species of fish and mussels that have lost habitat due to channel navigation projects. Consequently, species diversity would increase and the fishery in this area would improve. Placement of the closure structure and the vanes in the secondary channel would cover existing benthic habitat and organisms; however, the increase in substrate diversity and lotic habitat improvements would provide long-term benefits that outweigh any immediate losses. These structures would also prevent the loss of terrestrial habitat to erosion.

8.11.3 PLAN SELECTION

Construction of the partial closure structure (with or without the vanes) to benefit the secondary channel behind Diamond Island using 9-Foot Navigation Channel project authorities would be difficult to justify. There is no question the navigation project resulted in changes to this channel, though it appears that the more recent changes have been primarily fostered by changes in the Cannon River outlet. The following are the salient factors against implementation under navigation project authorities:

a. The modifications would provide no channel maintenance or navigation benefits.

b. There is no Federal land stewardship interest, i.e., Diamond Island and the adjacent Minnesota shoreline are in private ownership.

c. The project would involve construction of new structures that may have unforeseen future maintenance requirements.

Because of these factors, the selected plan relative to constructing the partial closure structure using navigation project authorities is the no action plan.

Construction of the project could be pursued under Section 206 or UMRS-EMP authorities, and possibly under Section 1135 authority. If a non-Federal sponsor expresses an interest in constructing these features using one of these other authorities, the St. Paul District would be willing to pursue the matter.

8.12 WISCONSIN CHANNEL

The Wisconsin Channel is a major secondary channel in upper pool 4, extending from river mile 793.5 to Lake Pepin. The Wisconsin Channel is considered a highly valuable resource, especially from a fishery perspective. It was recognized that there are changes occurring to the Wisconsin Channel and other unnamed secondary channels in the area below the U.S. Highway 63 crossing of the floodplain. These changes are viewed as part of natural river processes.

A closing dam is located in the Wisconsin Channel approximately 3,300 feet downstream from the head of the channel. This closing dam was rehabilitated in the 1992. A notch was left in the structure to facilitate small boat passage. The Minnesota DNR expressed concern that since the closing dam was repaired, depths in the Wisconsin Channel appear to have been reduced and more flow is being captured by cuts leading to Mud Lake and Dead Slough Lake.

At the time of construction, the District did an analysis and found that for the 10-year, 7-day low flow discharge of 3,190 cfs, that the reduction in conveyance due to the closing dam repair was about 7%. It was estimated that this would result in a reduction in discharge of no more than 10% for the low flow condition. For higher flow conditions, especially those approaching the bank full condition, which transports most of the sediment, the reductions in conveyance area and discharge would be even less significant. Due to the relative insignificant change in discharge conditions, especially during the higher flow events, sediment deposition in the Wisconsin Channel or changes in flow to Mud Lake and Dead Slough Lake cannot be attributed to the closing dam repair.

No data is available to document the location and extent of depth reductions in the Wisconsin Channel. If it is occurring in the lower reaches of the Wisconsin Channel below U.S. Highway 63, it may be the result of the observed flow shift to the cuts leading to Mud Lake and Dead Slough Lake (less sediment carrying capacity in the Wisconsin Channel). No reason for this flow shift is readily evident. It is likely the result of natural changes occurring in this area.

The closing dam is the only Federal navigation structure within the Wisconsin Channel. It is unlikely that habitat restoration at any other location within the Wisconsin Channel could be accomplished using St. Paul District channel maintenance or natural resource management authorities. Because there are no other navigation structures in the Wisconsin Channel, there would be no linkage between channel maintenance authorities and habitat restoration. Habitat restoration could not be pursued under natural resource management authorities because the Federal government did not purchase any land for the 9-foot Navigation Channel project in pool 4 above Lake Pepin (aside from land in the immediate vicinity of Lock and Dam 3).

If a particular habitat restoration measure were to be identified in the future within the Wisconsin Channel, it could be pursued under the related authorities described in Section 1.6 of this report. As all of these authorities are permanent authorities and as such, would be available for use for any future projects. All of the authorities discussed in Section 1.6 would require a non-Federal sponsor to cost-share in the habitat restoration.

8.13 LOWER MUD LAKE

The lower portion of Mud Lake (below U.S. Highway 63) is shallow and turbid with little aquatic vegetation. No specific measures were identified to improve habitat quality in lower Mud Lake. It is unlikely that habitat restoration at Mud Lake could be accomplished using St. Paul District channel maintenance or natural resource management authorities. There are no navigation structures in this reach of the river and no channel maintenance has been required since 1972. Thus, there is no potential linkage between channel maintenance activities and habitat restoration. Habitat restoration could not be pursued under natural resource management authorities because the Federal government did not purchase any land for the 9-foot Navigation Channel project in pool 4 above Lake Pepin (aside from land in the immediate vicinity of Lock and Dam 3).

As discussed above for the Wisconsin Channel, habitat restoration at Mud Lake could be pursued under the related authorities described in Section 1.6 of this report.

8.14 DEAD SLOUGH LAKE

Dead Slough Lake is shallow and turbid with little aquatic vegetation. No measures were identified to improve habitat quality in Dead Slough Lake. The situation at Dead Slough Lake is similar to as discussed for Lower Mud Lake relative to accomplishing habitat restoration under St. Paul District channel maintenance or natural resource management authorities.

As discussed above for the Wisconsin Channel, habitat restoration at Dead Slough Lake could be pursued under the related authorities described in Section 1.6 of this report.

8.15 HEAD OF LAKE PEPIN/LAKE PEPIN

8.15.1 CONCERNS

8.15.1.1 Sediment Resuspension

At about river mile 784 (plate 36), commercial tows exit Lake Pepin and enter the Mississippi River main channel (or vice versa). Navigation channel water depths in portions of this area are in the 12-14 foot range. The sediments in this area are relatively fine and it is believed that the navigation channel to some degree is kept open by commercial tow traffic. The Corps of Engineers on occasion is required to dredge in this area, though the dredging is generally required because of point bar encroachment into the channel, not an overall shallowing of the channel.

Resuspension of contaminated fine-grained sediment is a concern as this may make these contaminants available for bioaccumulation by river organisms. Concern has been expressed with the possible water quality effects of sediment resuspension by commercial tows.

These same concerns also exist for Lake Pepin itself. There are no designated travel routes for commercial tows in Lake Pepin. Concern has been expressed that it would be preferable for commercial tows to follow the deepest water possible and follow a consistent travel route when traversing Lake Pepin to minimize the potential for sediment resuspension.

No structural measures were identified that would address these concerns. From at least river mile 784 upriver, the channel is relatively well defined. Maintaining a deeper navigation channel to reduce sediment resuspension would not be practical, due both to the cost and the problem of finding acceptable placement sites for large quantities of mildly contaminated dredged material.

Additional channel marking within Lake Pepin was identified as a possible means of addressing the concerns with sediment resuspension within the lake. The channel is currently marked to about river mile 783. Options identified included:

a. Increase the number of bouys in the currently marked reach

b. Mark the channel down to river mile 778

c. Mark a channel the entire length of Lake Pepin

d. Mark two channels the length of Lake Pepin, the idea being that this would provide tow operators a choice of channels depending upon wind direction.

Limited coordination with the towing industry has indicated that having two channels to chose from was probably not necessary from their perspective.

8.15.1.2 Filling of Lake Pepin

Concern has surfaced periodically dating back to the GREAT I study in the 1970's with sedimentation in Lake Pepin. The primary concern is with increased sedimentation resulting from land use changes over the last 150 years in the watersheds above the lake. It was suggested during the course of this study that a sediment trap in upper pool 4 may reduce channel maintenance requirements and also reduce sedimentation rates in Lake Pepin

8.15.1.3 Habitat Diversity at the Head of Lake Pepin

The ongoing filling at the head of Lake Pepin by sediment is changing the character of the head of the lake area. In some areas, this filling is occurring with fine sediments that are too flocculent to support aquatic vegetation or diverse benthic communities. It was identified that construction of low islands or underwater mounds using coarser sediments could provide better substrates for aquatic plant growth and benthic communities and improve overall habitat quality in this area.

8.15.2 EVALUATION

8.15.2.1 Channel Marking

No detailed evaluation was conducted for the channel marking options. The following lists the identified pros and cons associated with each option.

a. Increase the number of bouys in the marked reach down to mile 783

<u>Pros</u>

(1) Would help insure tows stay in the marked channel when entering the river from Lake Pepin.

<u>Cons</u>

(1) Would result in a minor increase in the channel marking requirements for the U.S. Coast Guard.

b. Mark the channel down to river mile 778

<u>Pros</u>

(1) Would insure that tows stay over the deepest water in an area of the lake where

water depths are less than 25 feet deep.

Cons

(1) Would increase the channel marking requirements for the U.S. Coast Guard.

c. Mark a channel the entire length of Lake Pepin

Pros

(1) Would insure that tows stay over the deepest water in the lake.

Cons

(1) Would increase channel marking requirements for the U.S. Coast Guard, possibly beyond their current capabilities.

(2) Would add buoys in Lake Pepin where they have not existed before which could present a hazard and/or a nuisance to recreational craft until the public becomes accustomed to their presence.

d. For options a. through c. above, marking the channel using GPS coordinates was identified as a potential option to physically marking the channel with buoys. The advantage would be the cost of installing and maintaining buoys could be avoided. It was considered beyond the scope of this study to conduct a detailed analysis of the feasibility of marking the navigation channel in Lake Pepin using GPS coordinates. Coordination with towing industry indicates that not all tow boats have GPS equipment, though that may change in the future as this technology becomes more popular.

8.15.2.2 Sediment Trap

Based on a hydraulic review and experience with the sediment trap at the mouth of the Chippewa River, it is readily apparent that constructing a sediment trap in upper pool 4 would not be a cost effective method for reducing channel maintenance requirements. The lack of a convenient, low cost hydraulic dredged material placement site and low dredging requirements in upper pool 4 were the primary factors in arriving at this determination.

Based on suspended sediment measurements, estimates of bed load, dredging records, and backwater deposition estimates, the total sediment load delivered to Lake Pepin is approximately 780,000 tons per year. Over 98 percent of this material is finer than sand. If a unit weight of 70 pounds per cubic foot were assumed, this would amount to 830,000 cubic yards (19 acre-feet) of sediment. For comparison purposes, the amount of sediment placed at the Diamond Bluff Pit site in 1998 was about 690,000 cubic yards. In other words, a very large amount of sediment enters Lake Pepin each year.

There are a number of technical, economic, and social concerns that would be associated with attempting to reduce the sedimentation rate in Lake Pepin through the use of sediment traps.

(1) A sediment trap capable of trapping both sand and fine sediments would have to be extremely large. It is unlikely that a sediment trap limited to the main channel could ever be constructed that would be effective in trapping fine sediments.

(2) The initial excavation and the periodic maintenance of the sediment trap would be very costly. As noted above, a sediment trap would not be cost effective in terms of reducing channel maintenance requirements in upper pool 4. Therefore, if pursued, a sediment trap would have to be for fish and wildlife habitat purposes. Under existing authorities, a non-Federal sponsor such as the States of Minnesota and/or Wisconsin would have to cost share the initial excavation of the sediment trap and assume the ongoing maintenance requirements.

(3) The results at the head of Lake Pepin may not be desirable. Sediment traps tend to trap coarse sediments most efficiently and fine sediments less efficiently. Coarse sediment (sand and the coarser silts) would be nearly eliminated from the sediment load entering Lake Pepin, leaving only the finest sediments which are easily redistributed by wind. This is not desirable because it results in delta expansion occurring as a broad uniform blanket of sediment rather than the more desirable mixture of natural levees, splays, mudflats, and channels that occurs with a variety of sediment types.

(4) Lake Pepin has been filling with sediment for centuries and will continue to do so into the future. The sedimentation rate over the 150 years has increased due to land use changes in the watersheds above the lake. Determining whether this increase is significant within the context of the total time Lake Pepin will exist is beyond the scope of this study. Significant support from Federal and State agencies and the public would be necessary to undertake an intensive management action (a sediment trap) that would involve substantial resource trade-offs (the habitat taken up by the sediment trap) and be relatively costly.

8.15.2.3 Habitat Diversity at the Head of Lake Pepin

The St. Paul District has only dredged the Head of Lake Pepin dredge cut two times in the past 30 years, the last being in 2000. Therefore, no evaluation was conducted of habitat enhancement opportunities at the head of Lake Pepin using material from channel maintenance dredging because it may be several years before the District has a need to dredge in this reach again.

8.15.3 RECOMMENDATIONS

8.15.3.1 Channel Marking

With regards to the Corps of Engineers' responsibility re: providing a safe channel with adequate depths for navigation, Lake Pepin is a unique situation in that there is more than adequate depth and width for commercial navigation. The Corps does not need to do anything to allow commercial traffic to pass through Lake Pepin.

Marking the navigation channel on the Upper Mississippi River, including Lake Pepin, is the responsibility of the U.S. Coast Guard. The Coast Guard has not marked a specific channel in the lake because in the past there has been a need identified for a marked channel.

Because marking a specific navigation channel in Lake Pepin is not a Corps of Engineers responsibility, study effort was not applied to this issue beyond the identification of concerns, brainstorming of potential solutions, and some initial coordination efforts. The recommendation of this study is that this matter be referred to the Navigation Work Group of the River Resources Forum for further evaluation and consideration.

As a matter of record, the Wisconsin DNR has indicated they would advocate marking the channel to river mile 778 (option b.) as a minimum, with further consideration of marking a channel through the entire lake. The Minnesota PCA advocates pursuing marking a channel through the entire lake using GPS coordinates.

8.15.3.2 Sediment Traps

Constructing a sediment trap in lower pool 4 would not be cost effective from the perspective of maintaining the navigation channel and thus, will not be pursued by the St. Paul District under 9-Foot Navigation project authority. Using sediment traps to reduce the sedimentation rate in Lake Pepin is a resource management decision beyond the scope of this study. A major resource management decision would be required on the part or resource management agencies and the public to further pursue this option.

8.15.3.3 Habitat Diversity at the Head of Lake Pepin

If a non-Federal party expresses an interest pursuing habitat enhancement in the head of Lake Pepin area under one of the authorities listed in Section 1.6, the St. Paul District would be willing to pursue this further.

The next time channel maintenance dredging is required at the head of Lake Pepin, the St. Paul District would be willing to consider placement of the material for habitat purposes in this area. Advanced planning is not considered necessary at this time, as the next dredging event is likely to be several years off. In the interim, the conditions at the head of Lake Pepin may change and there may be habitat restoration efforts implemented under other authorities such as

the UMRS-EMP. In addition, it will be important to know the quantity and the physical and chemical characteristics of the material to be dredged before investing any appreciable time and effort into planning its use for habitat purposes. The material may be too fine for use, or contain contaminants at levels making open water placement unacceptable. This information generally will not be available until the specific dredging requirement is identified.

8.16 SUMMARY

Table 8-9 summarizes the problems, opportunities, and concerns addressed by this study and the recommendations contained herein.

Table 8-9
Summary of Problems, Opportunities, Concerns, and Recommendations

Feature/Problem	Purpose	Recommendation
Lock and Dam 2 lateral current	N	Further study by St. Paul District
Lock and Dam 2 flats	E	No action*
Conley Lake	E	No action*
Carter Slough	E, N	Construct new spot dike
Four Mile Island	N	No action
Big River	N, CM	Restore four wing dams
Coulters Island and Morgans Coulee	CM	No action
North and Sturgeon Lakes	E	Defer pending action by Fish and Wildlife Work Group
Wing Dam notching	E	Notch 18 wing dams
Wing Dam removal	E	Remove a section of one wing dam
Diamond Island	E	No action*
Wisconsin Channel	E	No action*
Lower Mud Lake	E	No action*
Dead Slough Lake	E	No action*
Head of Lake Pepin habitat enhancement	E	No action*
Lake Pepin channel marking	E	Further study by the Navigation Work Group

N = navigation; CM = channel maintenance; E = environmental

* No action at this time under District navigation project authorities. Projects could be pursued under other authorities if a non-Federal sponsor expresses an interest.

SELECTED PLAN WITH DETAILED DESCRIPTION/DESIGN AND CONSTRUCTION CONSIDERATIONS

This section provides more specific information concerning features selected for implementation. Table 9-1 summarizes these features. The source of funding for all of the recommended features would be the St. Paul District's operation and maintenance budget for the Mississippi River Nine-Foot Channel Project. The implementation date is based on the estimated availability of funds.

Table 9-1
Summary of Selected Plan

Feature	Cost	Estimated Implementation Date
Carter Slough Spot Dike	$86,500	2001 or 2002
Restore Wing Dams 804.9L, 805.1L, 805.2L and 805.25L	$67,200	2001 or 2002
Notch 18 Wing Dams	$57,400	2001 or 2002
Remove Part of Wing Dam 809.5R	$10,100	2001 or 2002

9.1 CARTER SLOUGH SPOT DIKE

The selected plan is to construct a new spot dike at Carter Slough as shown on plate 21. Construction is currently scheduled for 2001 or 2002, depending upon the availability of funds. Construction will be either by the District hired labor crew or by construction contract, depending upon workload demands at the time. However, given the scope of the project, construction by the District hired labor crew is the more likely scenario.

An estimated 430 cubic yards of rock would be required for this feature which would come from a quarry in the area. Rock loading would take place at a location dependent upon the location of the quarry.

Some site preparation for project construction would be required. Snag removal and access dredging will be necessary, as there is a substantial amount of debris buildup in the mouth of Carter Slough. The woody snags and debris would be placed on the shoreline on either side of Carter Slough.

It is estimated that about 5,000 cubic yards would need to be dredged from the mouth of Carter Slough for equipment access. The amount of dredging required could decrease depending upon water levels at the time of construction. The decision concerning what to do with the access dredging material will be made in coordination with the On-Site Inspection Team at the time of construction. At present, it is assumed the material would need to be barged away to an

approved dredged material placement site. The material would likely be taken to one of the sites located just below Lock and Dam 2, the Hastings Harbor site, or Corps Island, depending upon which is more economical and/or there is a need for the material.

No monitoring of this feature will be required. The feature will be inspected on a periodic basis along with all of the other pool 3 spot dikes.

9.2 RESTORATION OF WING DAMS 804.9L, 805.1L, 805.2L and 805.25L

The selected plan is to restore wing dams 804.9L, 805.1L, 805.2L and 805.25L as shown on plate 23. Wing dams 805.1L and 805.2L would be notched for fish habitat improvement purposes. Construction is currently scheduled for 2001 or 2002, depending upon the availability of funds. Construction will be either by the District hired labor crew or by construction contract, depending upon workload demands at the time. It is most likely that the work would be done by the District hired labor crew.

An estimated 1,055 cubic yards of rock would be required for this feature which would come from a quarry in the area. Rock loading would take place at a location dependent upon the location of the quarry.

Site preparation for project construction would be minimal. No access dredging is expected to be necessary. An estimated 33 cubic yards of material would be removed to notch wing dams 805.1L and 805.2L. Use of this material either for shoreline stabilization or creation of additional habitat structure would be coordinated with the On-Site Inspection Team.

Monitoring of this feature will consist of post-construction surveys on a periodic basis to evaluate bathymetric changes in the area.

9.3 WING DAM NOTCHING/REMOVAL

Because of the minor nature of each of the individual wing dam notchings and the removal of a portion of wing dam 809.5R, detailed construction plans will not be required. The work will be accomplished by the District hired labor crew as it fits into their schedule. It is expected that this work can all be accomplished by the end of the summer of 2002. Implementation will be coordinated with the On-Site Inspection Team.

Table 9-2 summarizes the design parameters for the wing dams selected for notching/partial removal. It is recognized that coordination with the On-Site Inspection Team may result in modification of these parameters based on site conditions at the time of construction. The use of the material excavated from the wing dams will be determined at the time of construction in coordination with the On-Site Inspection Team. The preferred use will be to place the material in the water adjacent to the wing dam in a manner to augment habitat

structure and diversity. In some locations, this material may be used to stabilize eroding banks if they are located in close proximity to the construction. It is proposed to spread the material removed from wing dam 809.5R upstream of the wing dam to create an area with a rubble substrate.

Table 9-2
Wing Dam Notching/Removal Design Parameters

Wing Dams	Notch Elevation	Notch Width	Excavation Quantity
809.5R	670.0	100 ft	380 cy
809.4R	669.8	20 ft	136 cy
809.3R	668.8	10 ft	90 cy
807.8R	669.8	50 ft	185 cy
807.6R	668.8	30 ft	16 cy
807.4R	668.8	50 ft	54 cy
807.3R	668.8	30 ft	38 cy
806.1L	666.6	15 ft	129 cy
801.7L	666.3	15 ft	84 cy
801.6L	668.3	20 ft	35 cy
801.4L	666.3	15 ft	208 cy
800.6R	666.2	10 ft	82 cy
800.4R	668.2	20 ft	46 cy
800.3R	666.2	10 ft	63 cy
800.0L	666.2	10 ft	31 cy
799.8L	666.2	10 ft	31 cy
799.7L	666.2	10 ft	31 cy
797.6L	666.0	20 ft	113 cy
797.5L	666.0	20 ft	113 cy

Bathymetric surveys of the notched wing dams will be conducted 3-5 years post-construction and repeated, if necessary, to assess the success of this technique for creating bathymetric diversity. The District will rely upon evaluation by resource management agencies to determine any biological changes that occur as a result of the notching.

ENVIRONMENTAL ASSESSMENT

An environmental analysis has been conducted for the proposed action, and a discussion of the impacts follows. As specified by Section 122 of the 1970 Rivers and Harbors Act, the categories of impacts listed in table 10-1 were reviewed and considered in arriving at the final determinations. In accordance with COE regulations (33 CFR 323.4(a)(2)), a Section 404(b)(1) evaluation has been prepared and is contained in Appendix E. State water quality certifications, as required by Section 401 of the Clean Water Act, will be obtained from Minnesota and Wisconsin.

The Final Environmental Impact Statement for the Channel Maintenance Management Plan (COE 1997) discussed the programmatic effects of the St. Paul District's channel management program. This channel management study for pool 3/upper pool 4 is part of that program.

The environmental assessment discusses the effects of the actions recommended for implementation including:

- Notching 18 wing dams and removal of a section of another to increase habitat diversity and productivity.

- Restoration of four wing dams (804.9L, 805.1L, 805.2L, 805.25L) for navigation, and notching two of those (805.1L and 805.2L) to maintain habitat diversity and productivity.

- Construction of a new spot dike at Carter Slough (river mile 807.3) to eliminate bypass flows in order to maintain navigation in pool 3 and to prevent habitat degradation in Mud Hen Lake.

10.1 APPLICABLE ENVIRONMENTAL LAWS AND REGULATIONS

This assessment was prepared and the proposed work designed to comply with all applicable environmental laws and regulations, including the following: National Environmental Policy Act of 1969; Executive Order 11514, Protection and Enhancement of Environmental Quality (as amended in Executive Order 11991); Executive Order 11593, Protection and Enhancement of the Cultural Environment; Executive Order 11990, Protection of Wetlands; Clean Air Act of 1977; Clean Water Act of 1977; Endangered Species Act of 1973; Fish and Wildlife Coordination Act; National Historic Preservation Act; 40 CFR 1500-1508, Council on Environmental Quality, Regulations for Implementing Procedural Provisions of the National Environmental Policy Act of 1969.

Table 10-1. Environmental Assessment Matrix for Pool 3/Upper Pool 4 Channel Management Plan
Section 122 of the River and Harbor and Flood Control Act of 1970 (P.L. 91-611)

	MAGNITUDE OF PROBABLE EFFECTS						
	BENEFICIAL			NO	ADVERSE		
PARAMETER	SIGNIFICANT	SUBSTANTIAL	MINOR	EFFECT	MINOR	SUBSTANTIAL	SIGNIFICANT
A. SOCIAL EFFECTS							
1. Noise Levels				X			
2. Aesthetic Values				X			
3. Recreational Opportunities				X			
4. Transportation				X			
5. Public Health and Safety				X			
6. Community Cohesion (Sense of Unity)				X			
7. Community Growth and Development				X			
8. Business and Home Relocations				X			
9. Existing/Potential Land Use				X			
10. Controversy				X			
B. ECONOMIC EFFECTS							
1. Property Values				X			
2. Tax Revenue				X			
3. Public Facilities and Services				X			
4. Regional Growth				X			
5. Employment				X			
6. Business Activity				X			
7. Farmland/Food Supply				X			
8. Commercial Navigation			X				
9. Flooding Effects				X			
10. Energy Needs and Resources				X			
C. NATURAL RESOURCE EFFECTS							
1. Air Quality					X		
2. Terrestrial Habitat			X		X		
3. Wetlands				X			
4. Aquatic Habitat			X		X		
5. Habitat Diversity and Interspersion			X				
6. Biological Productivity			X				
7. Surface Water Quality			X		X		
8. Water Supply				X			
9. Groundwater				X			
10. Soils				X			
11. Threatened or Endangered Species				X			
D. CULTURAL RESOURCE EFFECTS							
1. Historic Architectural Values					X		
2. Pre-Historic & Historic Archeological Values				X			

10.2 NATURAL RESOURCES EFFECTS

10.2.1 AIR QUALITY

The use of heavy equipment for dredging and rock placement would generate air emissions from the use of petroleum products to run the equipment. Very localized, minor degradation of air quality would occur during the construction phase.

10.2.2 WATER QUALITY

See the Section 404(b)(1) evaluation (appendix D) for a more detailed discussion of the impacts on water resources. The mechanical dredging and rock placement activities associated with structure modification, repair, or creation would resuspend river sediments during the operation. This would cause adverse impacts on filter-feeding benthic organisms and the planktonic community. These communities should recover fairly quickly after construction is complete. The effects on surface water quality by wing dam alterations would be confined to a very localized area around each of the construction sites. This would also be true regarding the construction of the Carter Slough spot dike; however, the dike will reduce the amount of sediment entering Mud Hen Lake, thus having a minor beneficial effect on water quality there. Also, this elimination of flow entering Mud Hen Lake may reduce winter dissolved oxygen levels. Placement of the clean, coarse rock at these construction sites would not cause any appreciable effects on water quality. It is unlikely that the sediments exposed in the scour hole created by wing dam notches would contain high levels of contaminants; however, a sediment analysis will be conducted prior to construction to verify this. If this analysis shows high levels of contaminants, the notches will not be constructed.

10.2.3 HABITAT

For most of the proposed wing dam notching sites, the effects on hydrodyanimc conditions is anticipated to be very localized. Flow through the wing dams notches would be increased, with a resultant scour hole developing downstream of the notch. The small amount of material that would be eroded would become part of the normal bedload moving through the area. The notch for wing dam 809.5R would be much larger than those of the other wing dams and would be about 100 feet wide. This would provide a larger area of increased substrate diversity, and would also increase the flow over wing dams 809.4R and 809.3R, thereby possibly increasing the effectiveness of their notches. In addition to providing localized habitat diversity, wing dams 807.8R, 807.6R, 807.4R, and 807.3R are being notched to increase flow and water depths in this secondary channel. It is hoped that a deeper, higher flow submerged channel with scour holes would develop in this area.

Material from the notches would be used for any of the following features as deemed appropriate: rock mounds or bars downstream or upstream of the present structures; rock groins or vanes for stabilizing adjacent shorelines; wing extensions perpendicular to the existing

structures (upstream or downstream); placement elsewhere on the existing structures to increase bathymetric and flow diversity. These submerged features would have very minimal, localized impacts on hydrodynamic conditions and should provide the benefit of increased bathymetric and substrate diversity. Construction of structures to prevent bank erosion may initially have a minor adverse effect on terrestrial habitat, as the removal of some tress may be necessary. However, during the long term they will prevent bank erosion, thereby protecting this habitat.

The purpose of the spot dike at the mouth of Carter Slough is to prevent flows from entering Mud Hen Lake during normal conditions, thereby maintaining the navigation pool. This would also help prevent habitat degradation in Mud Hen Lake caused by sedimentation. During construction of the dike a small amount a terrestrial habitat may be disturbed to tie the structure into the bank. Also, mechanical dredging may be necessary to gain access to the site. Material dredged from Carter Slough would be barged to a long-term upland disposal site approved in the Channel Maintenance Management Plan (CMMP). Elimination of flows in Carter Slough will eliminate or degrade its lotic habitat, and may result in decreased dissolved oxygen levels during winter in Mud Hen Lake. However, Carter Slough's lotic habitat presently appears to be of low quality, as does the fishery resource in Mud Hen Lake, which mainly supports undesirable fish species. These habitat losses are not substantial and the project will help prevent habitat succession in Mud Hen Lake, thereby maintaining it as valuable waterfowl habitat.

10.2.4 FISH AND WILDLIFE

Short-term, localized adverse impacts will be associated with wing dam notching. Mechanical dredging and rock placement will cause elevated levels of turbidity in the immediate vicinity. However, the material to be dredged is coarse and likely relatively clean, and mechanical placement should assure that no toxic effects occur. During construction, increases in turbidity would have localized suppressing effects on phytoplankton productivity. However, these local effects would be minor, and phytoplankton populations would recover quickly upon completion of construction activities.

Mechanical access dredging will also be required for the Carter Slough spot dike construction. Material dredged from Carter Slough would be barged to a long-term upland disposal site approved in the CMMP. Mechanical dredging should minimize the possibility of any toxic effects.

During project construction, bird, mammal, and fish species in the project vicinity could be negatively affected by the noise and disturbance caused by heavy equipment operating in the area. The disturbance would be short-term.

Placement of rock obtained from notching the wing dams either the downstream scour hole area or on top of the submerged structure may result in covering benthic organisms. However, it would provide more diverse substrate suitable for colonization by aquatic invertebrates and cover for fish species. The excavated rock/sand could also be used for bank protection of adjacent eroding shores at some of the wing dam notching sites. Benefits to habitat

diversity and interspersion would be realized under all the options being considered for the excavated rock from the wing dam notches.

10.2.6 THREATENED AND ENDANGERED SPECIES

A biological assessment for the proposed project features has been completed to determine the potential effects on the following federally listed species: Higgins' eye pearly mussel (*Lampsilis higginsi*) and bald eagle (*Haliaetus leucocephalus*).

The Higgins' eye pearly mussel has not been recorded in the last 35 years in pools 3 or 4 except for 100 individuals that were relocated to a site in upper pool 3 in October 2000. Mussel sled surveys were conducted by USACE in 1994 and 2000 at areas in pool 3 that would be impacted by the proposed actions. The Minnesota Department of Natural Resources (MNDNR) also conducted mussel surveys in pool 3 in July 2000. Only 13 species of mussels were found in surveys near project sites, with threeridge, threehorn, pink papershell, and pimpleback dominating the mussel assemblage. The MNDNR collected an additional 13 species outside the project areas in pool 3. No Higgins' eye pearly mussels were collected. Based on the survey results, with the absence of Higgins' eye pearly mussel, the low diversity, and the low total number of mussel collected, it is very unlikely that *L. higginsi* is present at any of the proposed project locations. The proposed project should have no effect on the Higgins' eye pearly mussel or its habitat.

Bald eagles use habitat in the general project area for overwintering. There are at least two eagle overwintering roosts in the study area, one near the confluence of the Vermillion and Mississippi rivers, and one between Red Wing and Wacouta. Downstream of the project area in lower pool 4 at Reads Landing, a high concentration of wintering eagles is present annually. There have also been reports of nesting activity by eagles in pools 3 and 4; however, no active nesting sites are known to be present close to the project areas. With the exception of the Carter Slough spot dike, all the proposed actions occur adjacent to the main navigation channel, which is already subject to high levels of human activities from recreational and commercial traffic. Furthermore, wing dam notching is a relatively fast process that usually requires less than a day. Construction activities could potentially disrupt short-term use of the general area by bald eagles but the overall impact should be minimal.

The proposed project would have no effects on any federally listed threatened or endangered species or their critical habitat. The U.S. Fish and Wildlife Service concurs with this determination (Appendix F).

A number of state listed fish and mussel species are reported from the project area. Several Wisconsin and/or Minnesota listed fish species use main channel border or secondary channel habitats, the primary habitat types that would be impacted by the proposed project features. During construction, the placement of rock, sand, or other construction material would temporarily displace any fish from the project locations. No known important spawning or overwintering habitat for state listed fish species would be adversely impacted by the proposed

project features. The proposed modifications to existing wing dam structures could improve habitat for state listed fish species by providing areas of reduced flow, increased diversity of substrates and water depths, and additional cover. Mussel surveys completed in 1994 and 2000 at the proposed project locations mostly yielded commonly occurring species. It is the St. Paul District's conclusion the proposed project features would have no more than minor impacts on state listed threatened and endangered fish and mussel species. Because the project would have limited impacts on other natural resources and no impacts on federally listed threatened and endangered species, no project related impacts on state listed wildlife and plant species are anticipated. The Minnesota and Wisconsin Department of Natural Resources will receive a copy of this Environmental Assessment. Comments received pertaining to protection of threatened and endangered species will be addressed.

10.3 SOCIOECONOMIC EFFECTS

No appreciable socioeconomic effects have been identified. There would be noise associated with the operation of heavy equipment during project construction. However, there are no sensitive receptors in the area and most human activity consists of passing recreational craft.

All of the proposed wing dam modifications will occur to existing submerged structures, so there would be no visual effects from these actions. The new Carter Slough spot dike would be located in a wooded area that is visited infrequently by the public. The structure would not visible from the river.

If the wing dam notches are successful in improving localized fish habitat conditions as expected, some additional fishing opportunities will be created.

10.4 CULTURAL RESOURCE EFFECTS

There are no historic properties listed on the National Register of Historic Places that will be affected by this project. There are two potentially eligible properties that are within the project's area of potential effect: a historic farmstead at Carter's Slough, and the wing dams that are part of the channel constriction works of the pre-9-foot navigation channel project.

10.4.2 CARTER SLOUGH

A historic farmsite (21 DK 58) is known for the downstream bank of Carter Slough. The placement of a rock dike across Carter Slough has little or no potential to adversely affect the site. Effect will be avoided by keeping any staging activities away from the site area, and by minimizing any bank preparation necessary to tie in the rock dike.

10.4.3 BIG RIVER WING DAM AND WING DAM NOTCHING

The St. Paul District has determined that the channel constriction works (wing dams, closing dams, and shore protection) associated with the 4 ½- and 6-foot channel projects are eligible for the National Register of Historic Places. The District is currently working with the Minnesota and Wisconsin State Historic Preservation Offices (SHPOs) to further assess and document the eligibility of these historic resources. When the eligibility of the resources has had a final determination, then the District will work with the SHPOs to avoid, minimize and/or mitigate any adverse effects that might occur to the wing dams that are being modified. For the purposes of the present project, with the agreement of the SHPOs, the District has determined that the effect of notching/partial removal of 19 wing dams and restoring 4 wing dams on the overall resource (over 1,000 wing dams above La Crosse, Wisconsin) will not be significant. Most of the individual wing dams will suffer only minor effects or will be benefited by stabilization and restoration.

COORDINATION, PUBLIC VIEWS, AND COMMENTS

The study was initiated with an interagency coordination meeting held on July 20, 1998. Coordination throughout the study was maintained with and through agency representatives who for the most part are agency representatives on the On-Site Inspection Team for channel maintenance activities. Active participants included representatives of the U.S. Fish and Wildlife Service, the Wisconsin and Minnesota Departments of Natural Resources, the Minnesota Pollution Control Agency, and the Prairie Island Indian Community. Formal coordination meetings were held on the dates shown below. Coordination also took place on a regular basis between meetings through more informal means to facilitate the exchange of information.

July 20, 1998	January 19, 2000
May 27, 1999	October 11, 2000

In addition, the status of the study was reported on at the meetings of the River Resource Forum which occur in three time annually in April, August, and December.

A draft Problem Appraisal Report for the study was provided to the River Resources Forum on November 30, 19999. Following receipt of comments, the Problem Appraisal Report was finalized and provided to the River Resources Forum on March 9, 2000.

A public meeting for the study was held on March 27, 2000, in Red Wing, Minnesota. The meeting was attended by 9 private citizens and by representatives of interested Federal and State agencies. The primary purpose of the public meeting was to obtain public input concerning environmental and recreational problems and concerns in pool 3 and upper pool 4. No particular concerns were identified that could be addressed by the study. Public concerns expressed at the meeting primarily focused on shoreline erosion caused by recreational craft, a concern outside the authority of the Corps of Engineers to address.

The draft Definite Project Report/Environmental Assessment was circulated for review to the Congressional interests; Federal, State, and Non-Federal agencies; special interest groups; interested citizens; and others as listed in appendix F on March 2, 2001. Comment letters and responses are included in appendix F.

The River Resources Forum endorsed the study and the study recommendations on April 24, 2001.

SUMMARY

The purpose of this study was to undertake a holistic evaluation of channel management in pool 3 and upper pool 4. By necessity, problems, opportunities, and potential solutions had to be evaluated on a localized or site specific basis, within the context of their overall effect within the study area. A number of specific actions are recommended for implementation (table 9-1, page 9-1).

Additional study is recommended of a potential solution to a lateral current problem below Lock and Dam 2. Construction of a 600-foot extension of the lower guard wall in the form of a rock dike was identified as a potential engineering solution to the problem. Additional investigations beyond the scope of this study would be required before this solution could be implemented.

Construction of a new spot dike at Carter Slough (river mile 807.3) is recommended to prevent habitat degradation occurring as a result of a bypass of the existing spot dike, and to insure the long term integrity of pool 3.

Restoration of 4 wing dams on the left side of the navigation channel at river mile 805 is recommended to reduce shoaling in this area. The purpose is to make a bend in the navigation channel in this area more navigable and to reduce the potential for future dredging requirements.

Fish habitat benefits will be achieved through the notching of 18 wing dams and partial removal of another. The notches are designed to promote the formation of scour holes and channels to improve bathymetric diversity in relatively monotypic main channel border areas.

The recommended features are not solutions to all of the channel maintenance, environmental, and recreational problems and concerns identified in pool 3 and upper pool 4. In some instances, cost-effective solutions could not be found. In others, evaluation indicated that a wait-and-see approach was better, especially in areas where conditions are changing due to natural river dynamics. Finally, in some instances, solutions lie beyond the purview of the St. Paul District channel maintenance and natural resource management authorities, and other Federal and State agencies will need to take the lead in implementation.

Environmental and Economic Analysis Branch
Planning, Programs and Project Management Division

FINDING OF NO SIGNIFICANT IMPACT

In accordance with the National Environmental Policy Act of 1969, the St. Paul District, Corps of Engineers, has assessed the environmental impacts of the following project.

POOL 3/UPPER POOL 4 CHANNEL MANAGEMENT STUDY
POOL 3/UPPER POOL 4, UPPER MISSISSIPPI RIVER

The proposed actions and purposes of this channel management project are to: notch 19 wing dams to increase habitat diversity and productivity thereby reducing the negative environmental effects of these channel control structures; restore four wing dams (804.9L, 805.1L, 805.2L, 805.25L) to reduce sediment accretion in this reach, thereby improving navigability and reducing dredging requirements; notch two of the restored wing dams (805.1L, 805.2L) to maintain habitat and bathymetric diversity of the affected reach; construct a new spot dike at the mouth of Carter Slough (river mile 807.3) to limit flow through the slough in order to maintain the navigation pool and to reduce sedimentation in Mud Hen Lake. This Finding of No Significant Impact is based on the following factors: the proposed project would have minor beneficial impacts on wildlife and fishery resources, even though some temporary minor adverse impacts would occur; the project would have minor adverse impacts on the cultural environment; the project would have minor beneficial impacts on the economic environment; and the project would have no impacts on the social environment.

The environmental review process indicates that the proposed action does not constitute a major Federal action significantly affecting the quality of the human environment. Therefore, an environmental impact statement will not be prepared.

1 Jun 01
Date

Kenneth S. Kasprisin
Colonel, Corps of Engineers
District Engineer

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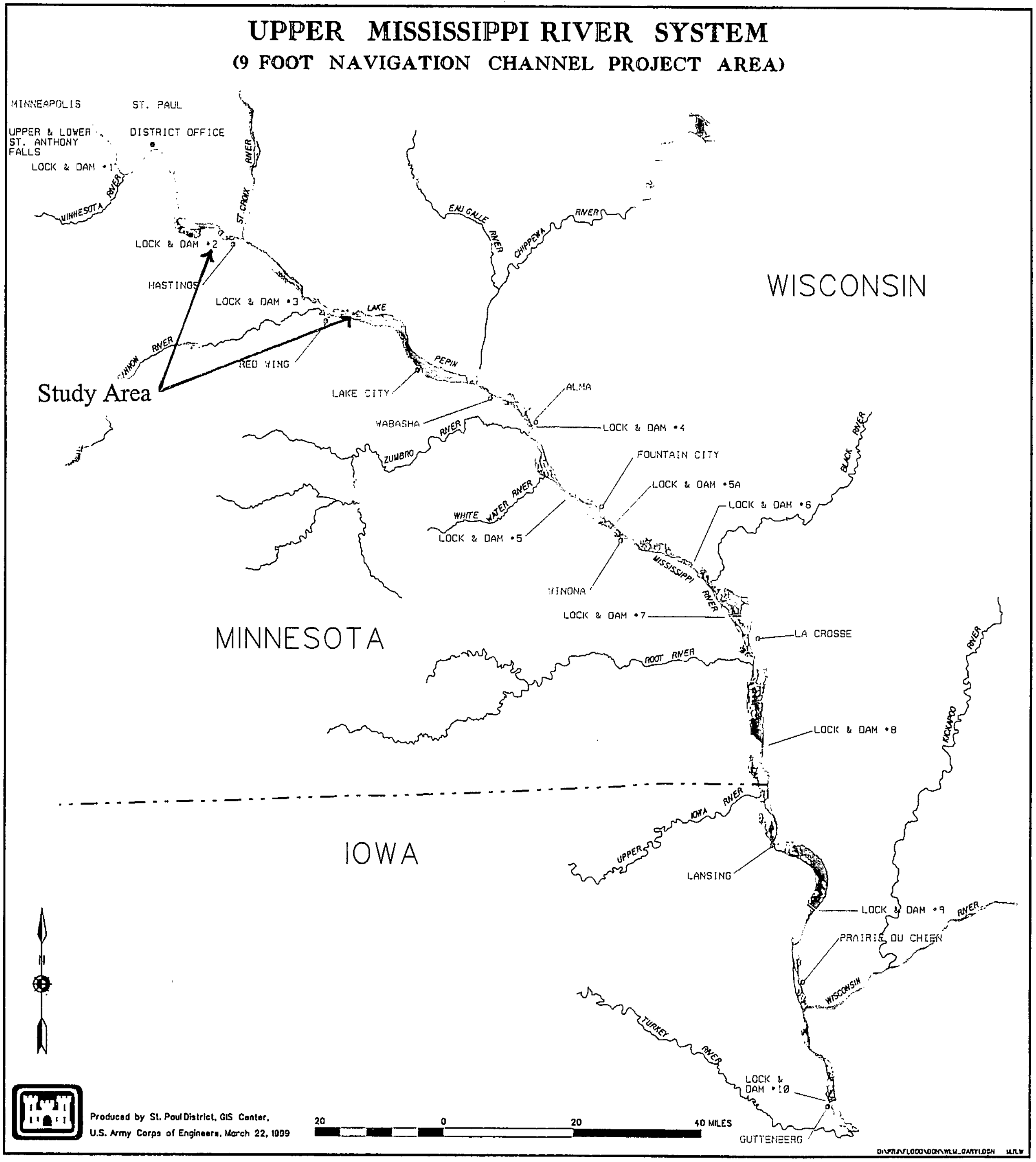
PLATES



UPPER MISSISSIPPI RIVER SYSTEM
(9 FOOT NAVIGATION CHANNEL PROJECT AREA)
MINNEAPOLIS
ST. PAUL
UPPER & LOWER ST. ANTHONY FALLS
DISTRICT OFFICE
LOCK & DAM #1
MINNESOTA RIVER
ST. CROIX RIVER
LOCK & DAM #2
HASTINGS
LOCK & DAM #3
LAKE PEPIN
CANNON RIVER
RED WING
Study Area
LAKE CITY
EAU GALLE RIVER
CHIPPEWA RIVER
WISCONSIN
ALMA
WABASHA
LOCK & DAM #4
ZUMBRO RIVER
FOUNTAIN CITY
LOCK & DAM #5A
BLACK RIVER
LOCK & DAM #6
WHITE WATER RIVER
LOCK & DAM #5
MISSISSIPPI RIVER
WINONA
LOCK & DAM #7
LA CROSSE
MINNESOTA
ROOT RIVER
KICKAPOO RIVER
LOCK & DAM #8
UPPER IOWA RIVER
IOWA
LANSING
LOCK & DAM #9
WISCONSIN RIVER
PRAIRIE DU CHIEN
TURKEY RIVER
LOCK & DAM #10
GUTTENBERG
Produced by St. Paul District, GIS Center, U.S. Army Corps of Engineers, March 22, 1999
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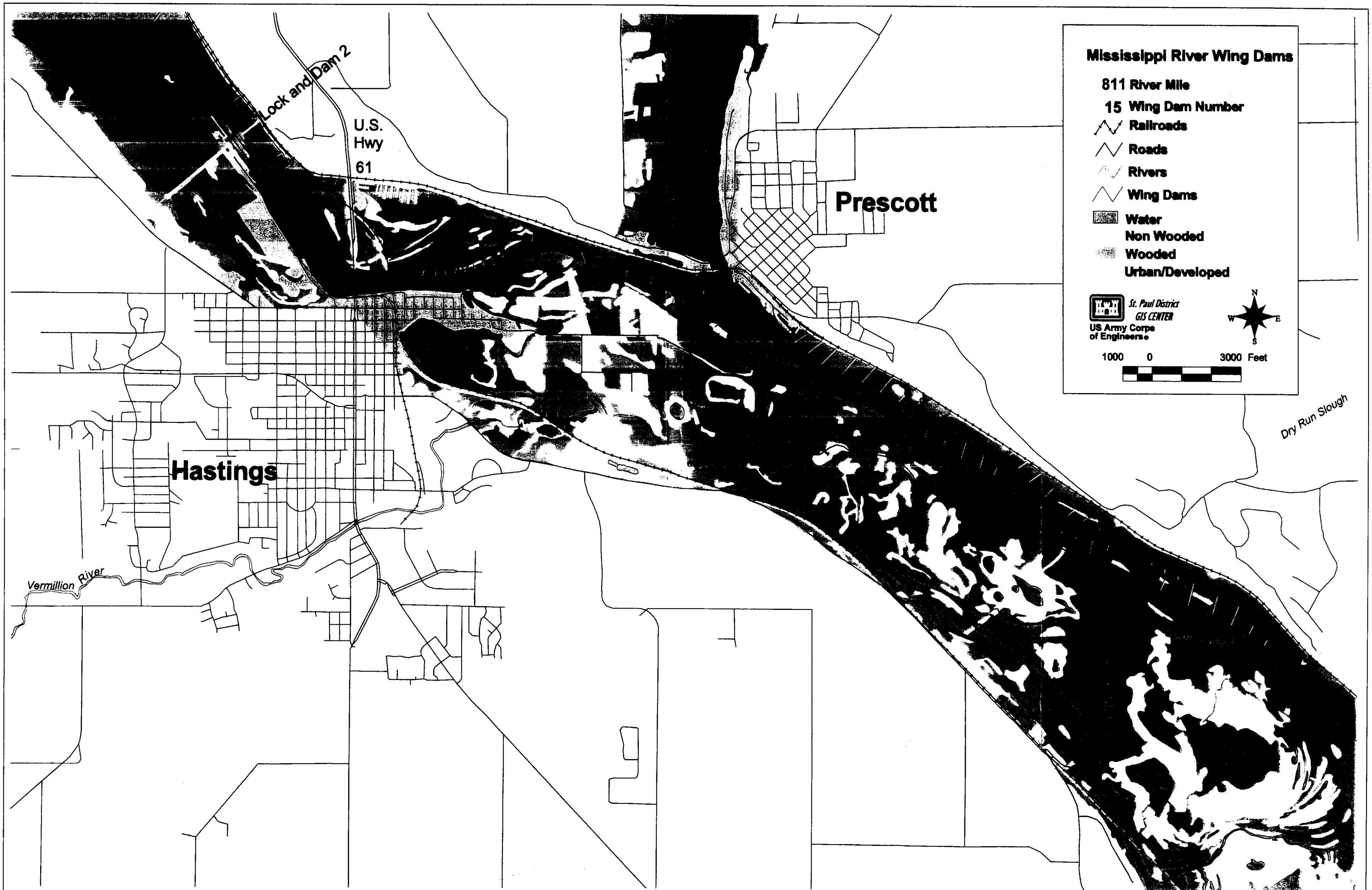
Plate 1


Mississippi River Wing Dams
811 River Mile
15 Wing Dam Number
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Roads
Rivers
Wing Dams
Water
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US Army Corps of Engineers
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Vermillion River
Dry Run Slough

Plate 2

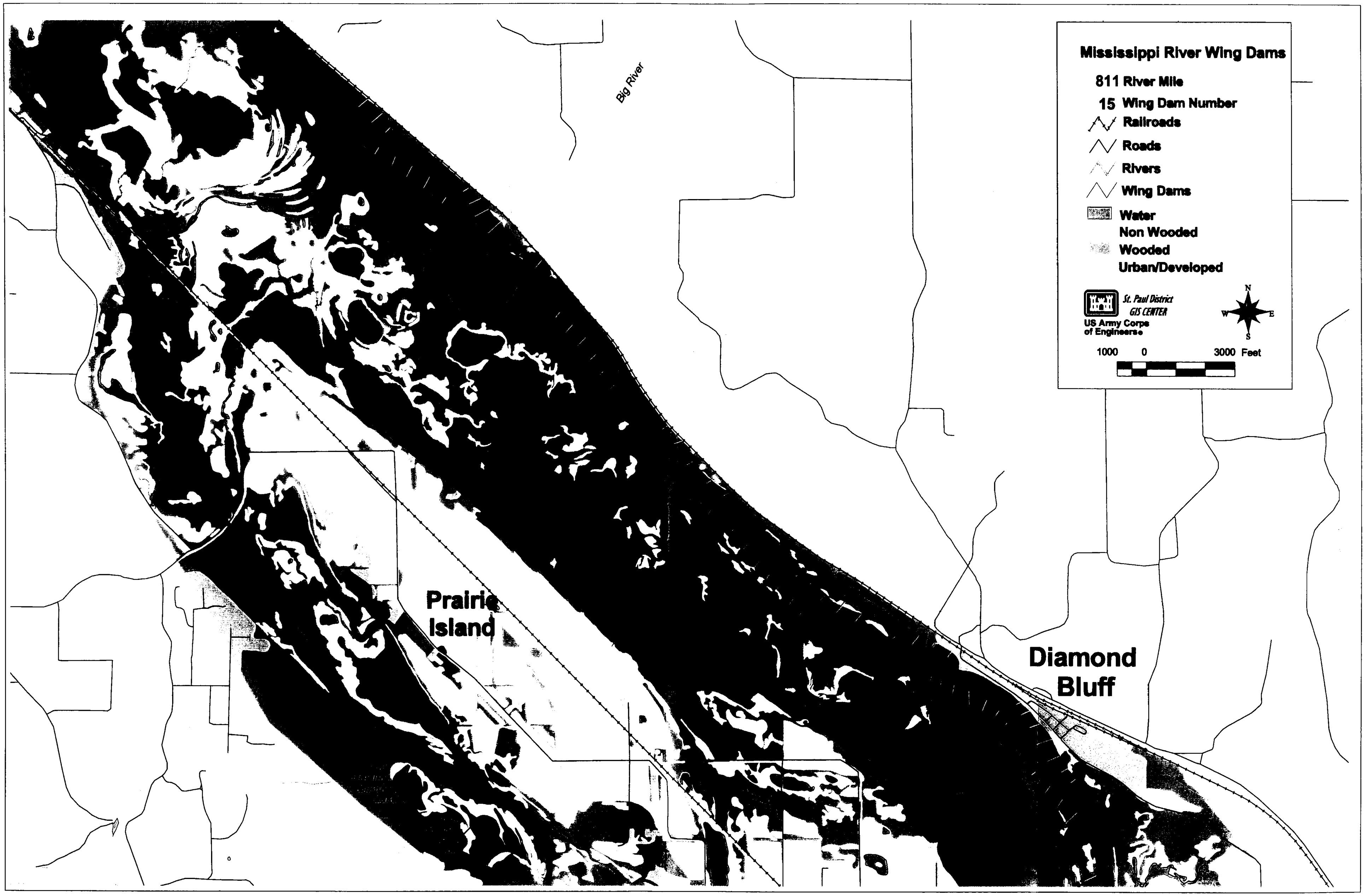
Big River
Prairie Island
Diamond Bluff
Mississippi River Wing Dams
811 River Mile
15 Wing Dam Number
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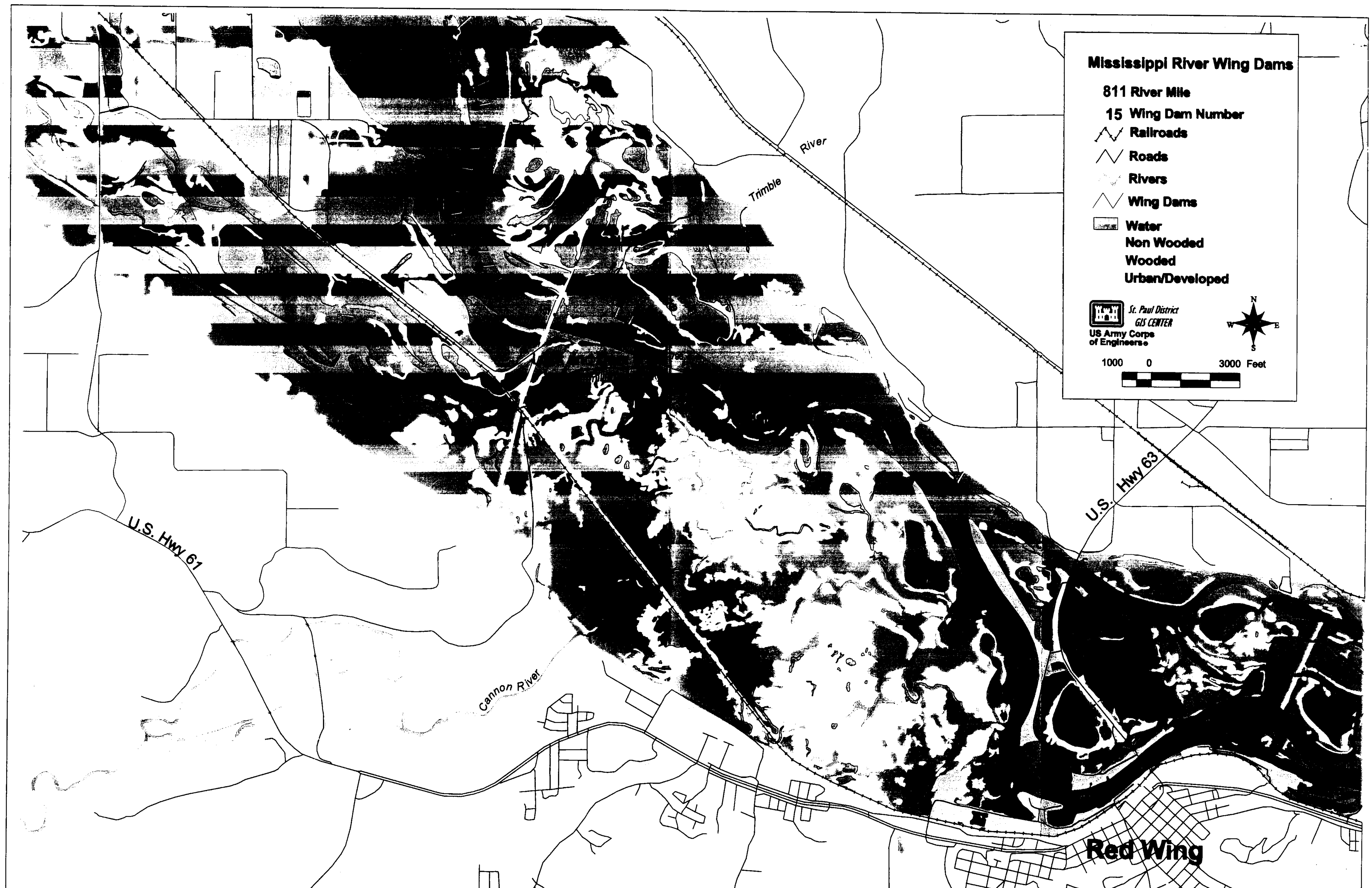
Plate 3


Mississippi River Wing Dams
811 River Mile
15 Wing Dam Number
Railroads
Roads
Rivers
Wing Dams
Water
Non Wooded
Wooded
Urban/Developed
St. Paul District
GIS CENTER
US Army Corps of Engineers
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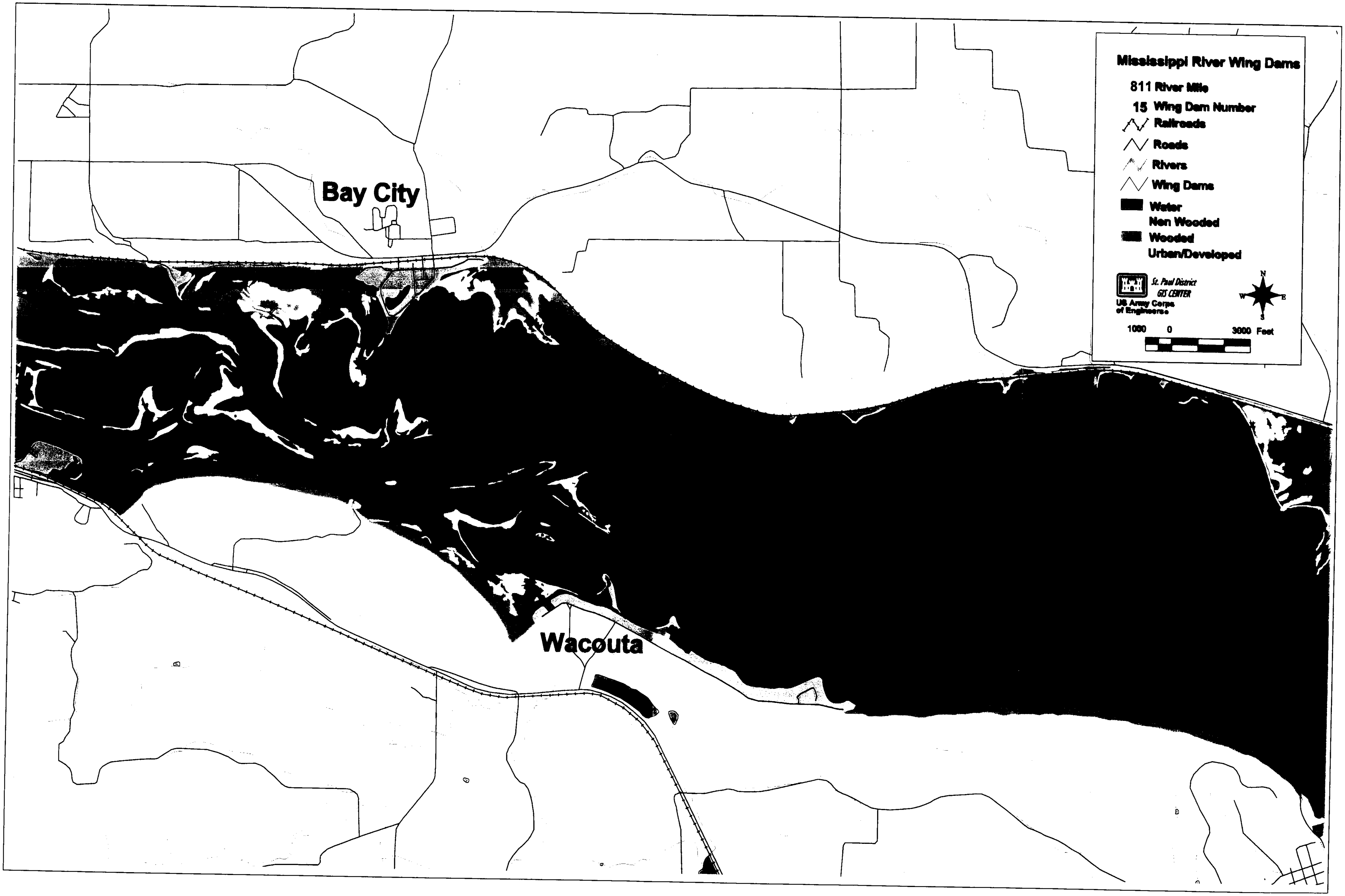
Trimble River
U.S. Hwy 63
U.S. Hwy 61
Cannon River
Red Wing

Plate 4


Bay City
Wacouta
Mississippi River Wing Dams
811 River Mile
15 Wing Dam Number
Railroads
Roads
Rivers
Wing Dams
Water
Non Wooded
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Urban/Developed
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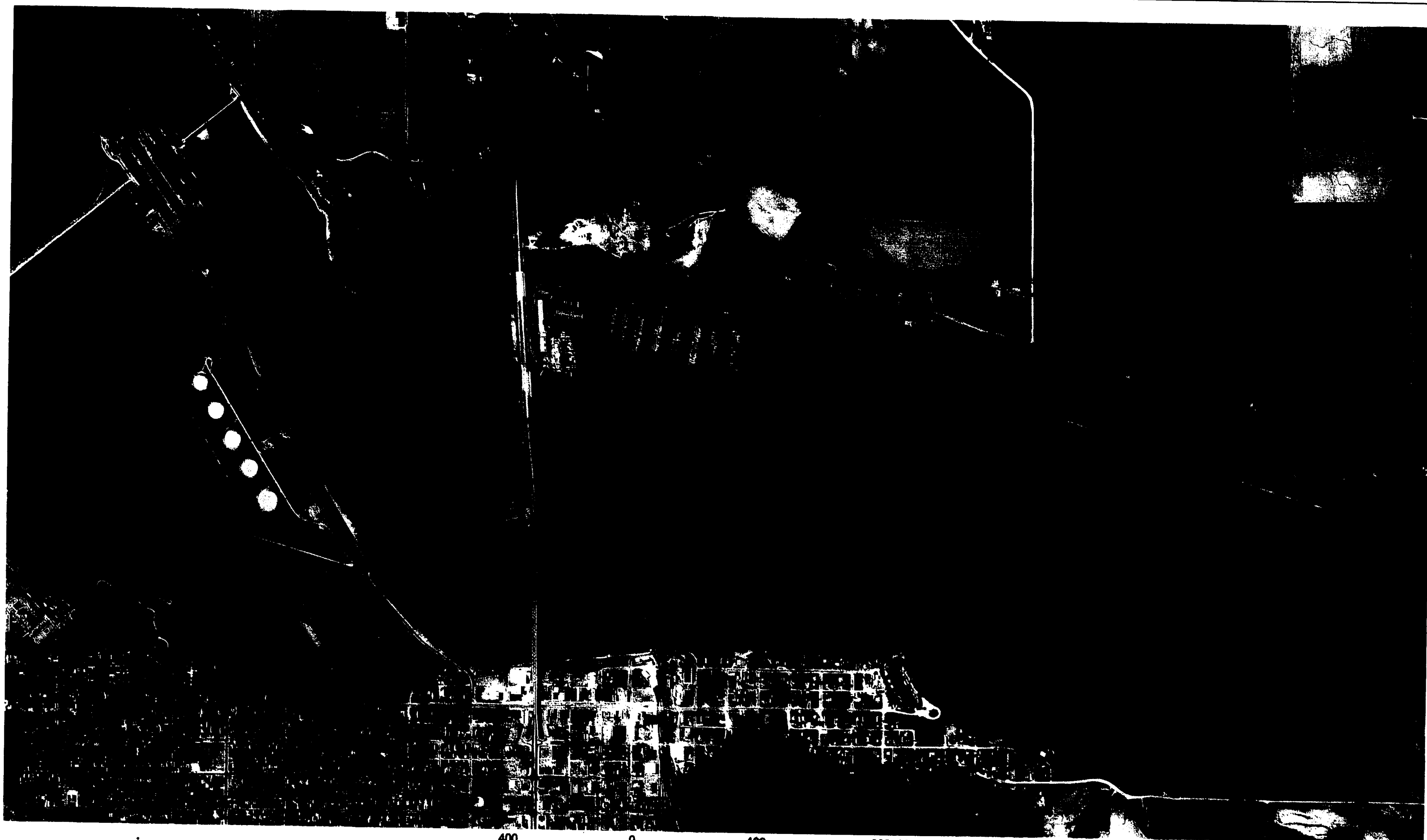
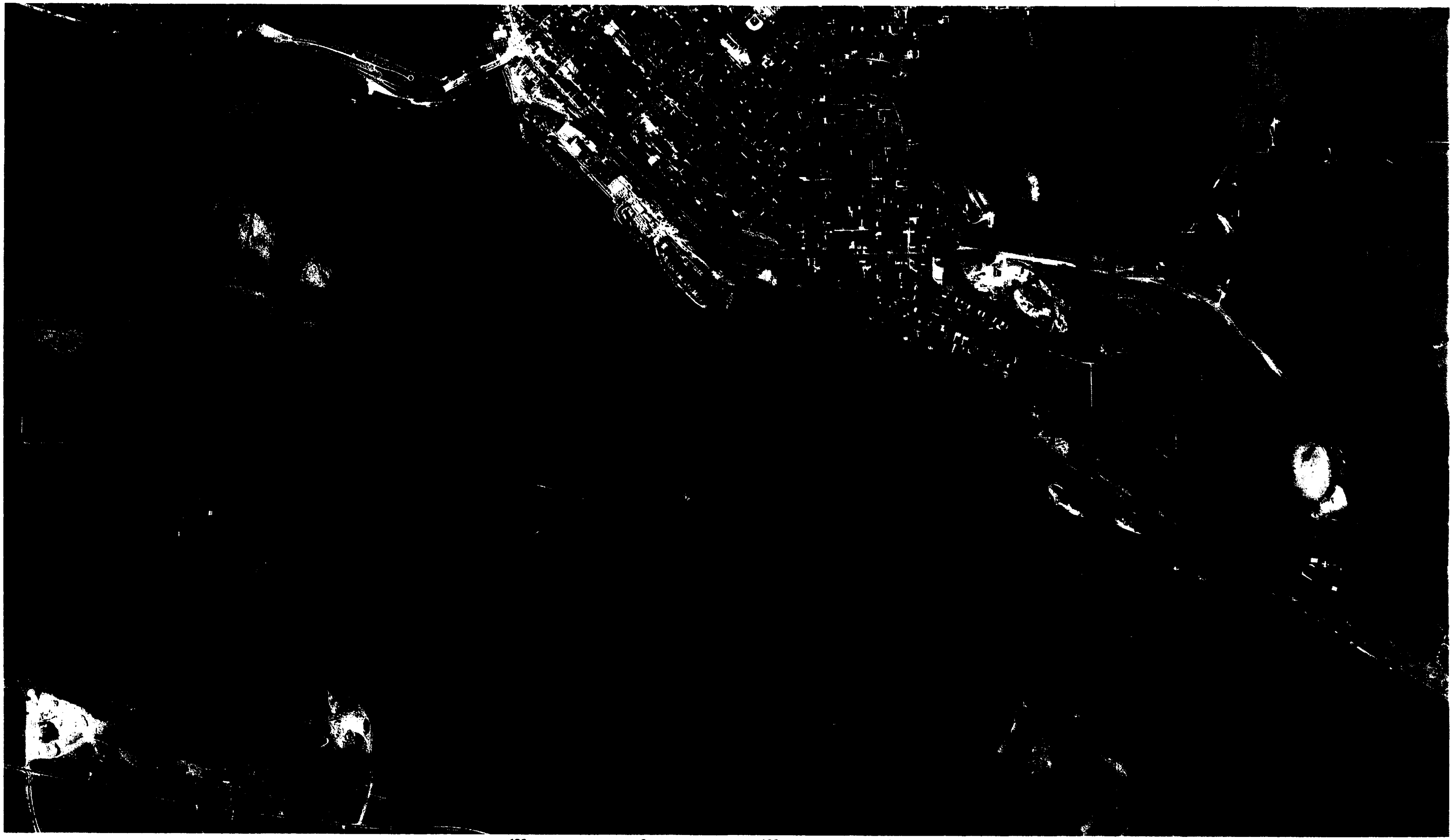


St. Paul District
GIS CENTER
US Army Corps
of Engineers

POOL 3 DREDGE CUTS

Image Data: USGS Digital Orthophoto - 7 May 1992

PLATE 6



St. Paul District
GIS CENTER
US Army Corps
of Engineers

POOL 3 DREDGE CUTS

Image Data: USGS Digital Orthophoto - 7 May 1992

PLATE 7

POOL 3 DREDGE CUTS

Image Data: USGS Digital Orthophoto - 7 May 1992

PLATE 8

St. Paul District
GIS CENTER
US Army Corps of Engineers

400 0 400 800 Meters
1000 0 1000 2000 Feet

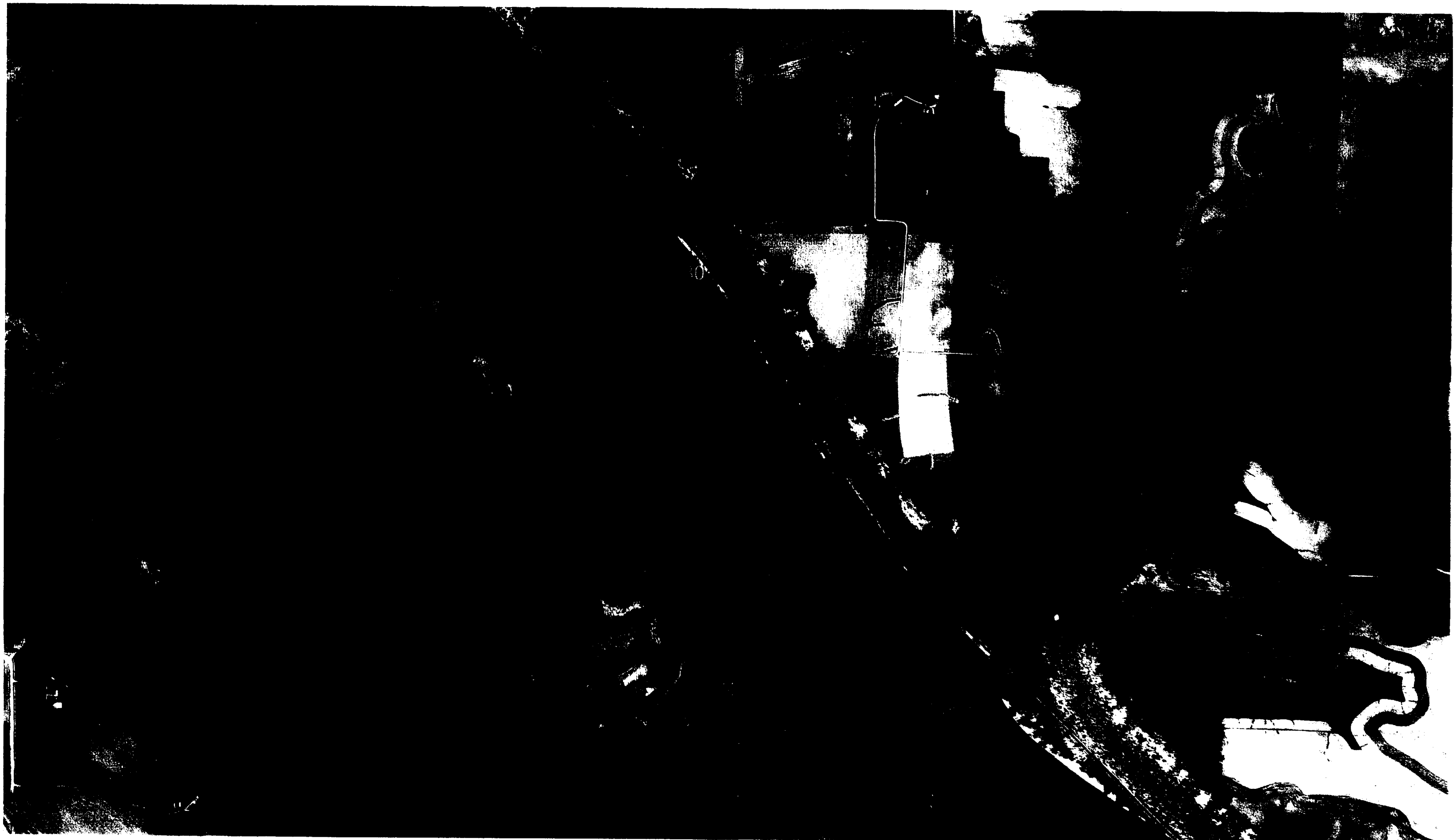
POOL 3 DREDGE CUTS

Image Data: USGS Digital Orthophoto - 7 May 1992

N W E S

River Mile
Wingdam
Dredge Cuts 1970 - 1979
Dredge Cuts 1980 - 1989
Dredge Cuts 1990 - 1995

PLATE 9

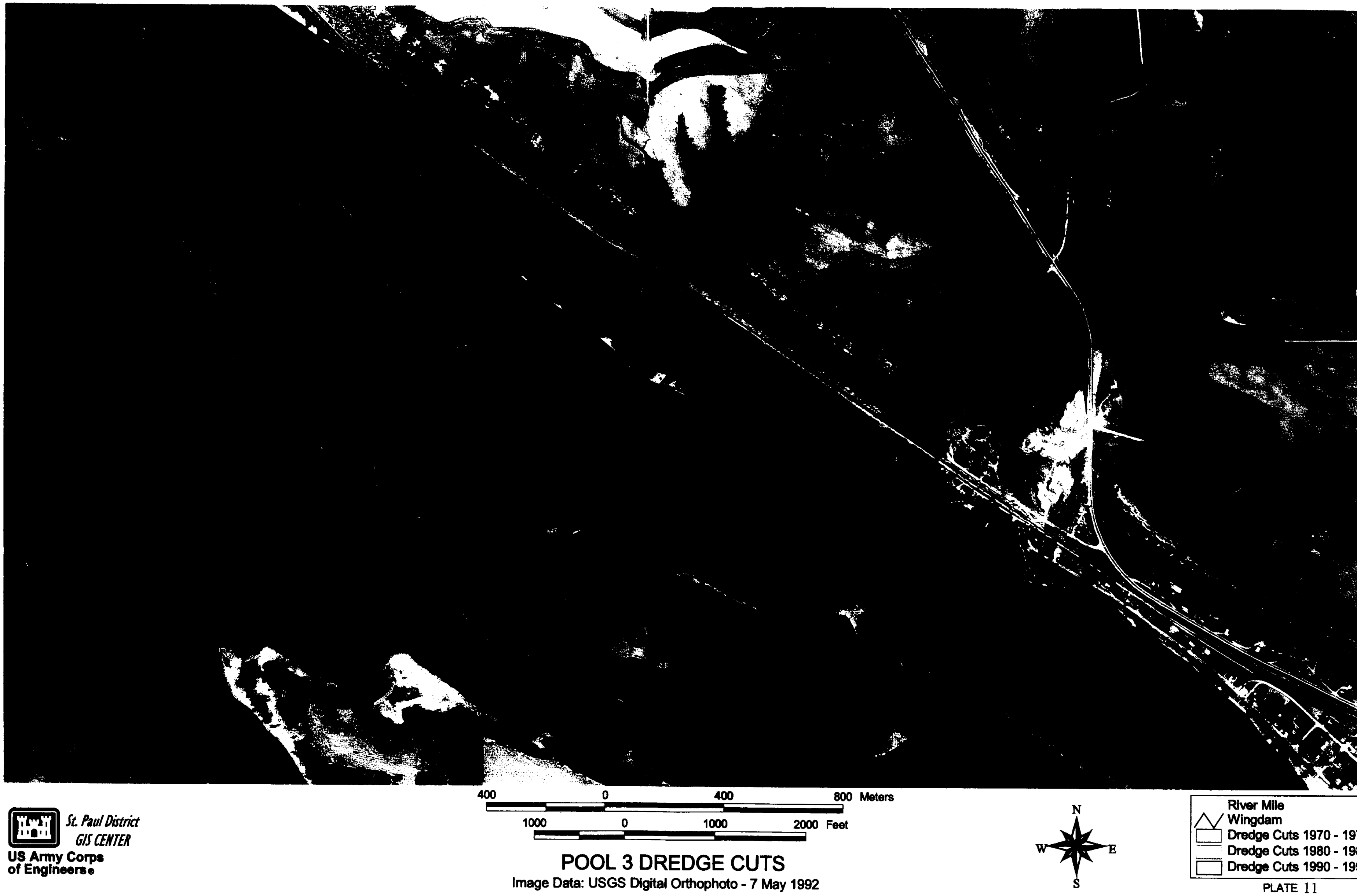


St. Paul District
GIS CENTER
US Army Corps
of Engineers

POOL 3 DREDGE CUTS

Image Data: USGS Digital Orthophoto - 7 May 1992

PLATE 10



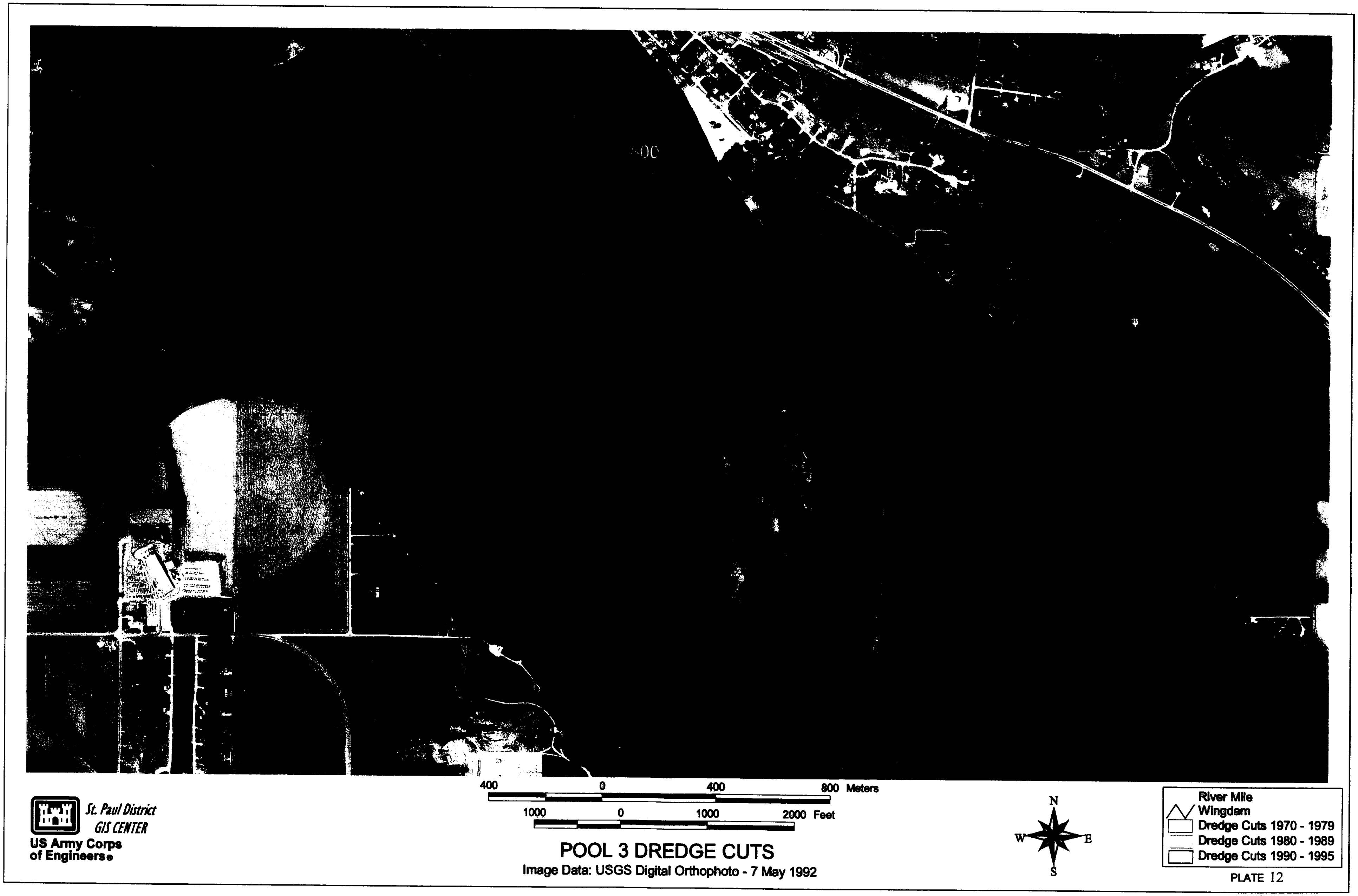
St. Paul District GIS CENTER

US Army Corps of Engineers

POOL 3 DREDGE CUTS

Image Data: USGS Digital Orthophoto - 7 May 1992

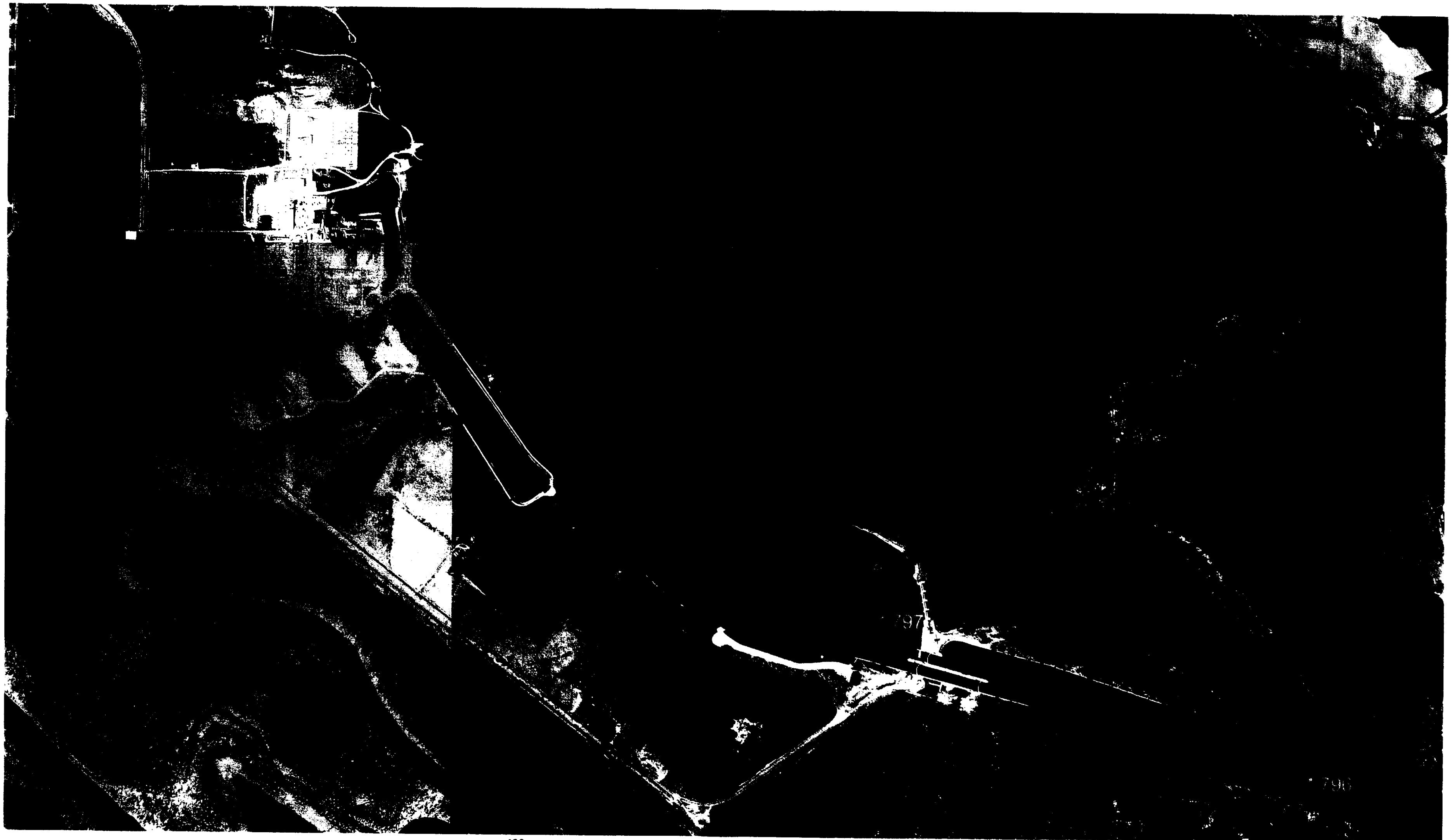
PLATE 11



POOL 3 DREDGE CUTS

Image Data: USGS Digital Orthophoto - 7 May 1992

PLATE 12



400 0 400 800 Meters
1000 0 1000 2000 Feet

St. Paul District
GIS CENTER
US Army Corps of Engineers

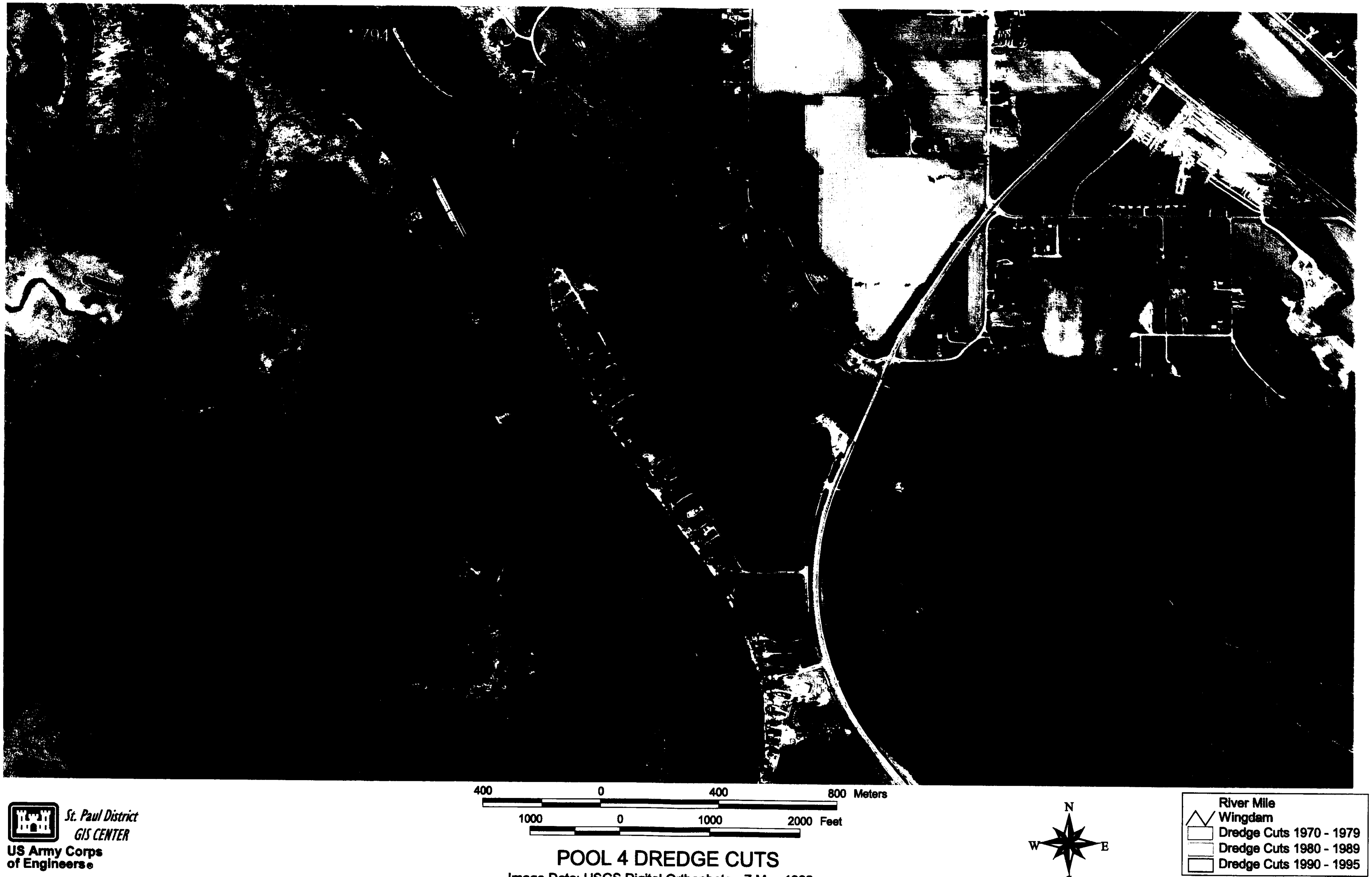
POOL 3 DREDGE CUTS

Image Data: USGS Digital Orthophoto - 7 May 1992

N W E S

River Mile
Wingdam
Dredge Cuts 1970 - 1979
Dredge Cuts 1980 - 1989
Dredge Cuts 1990 - 1995

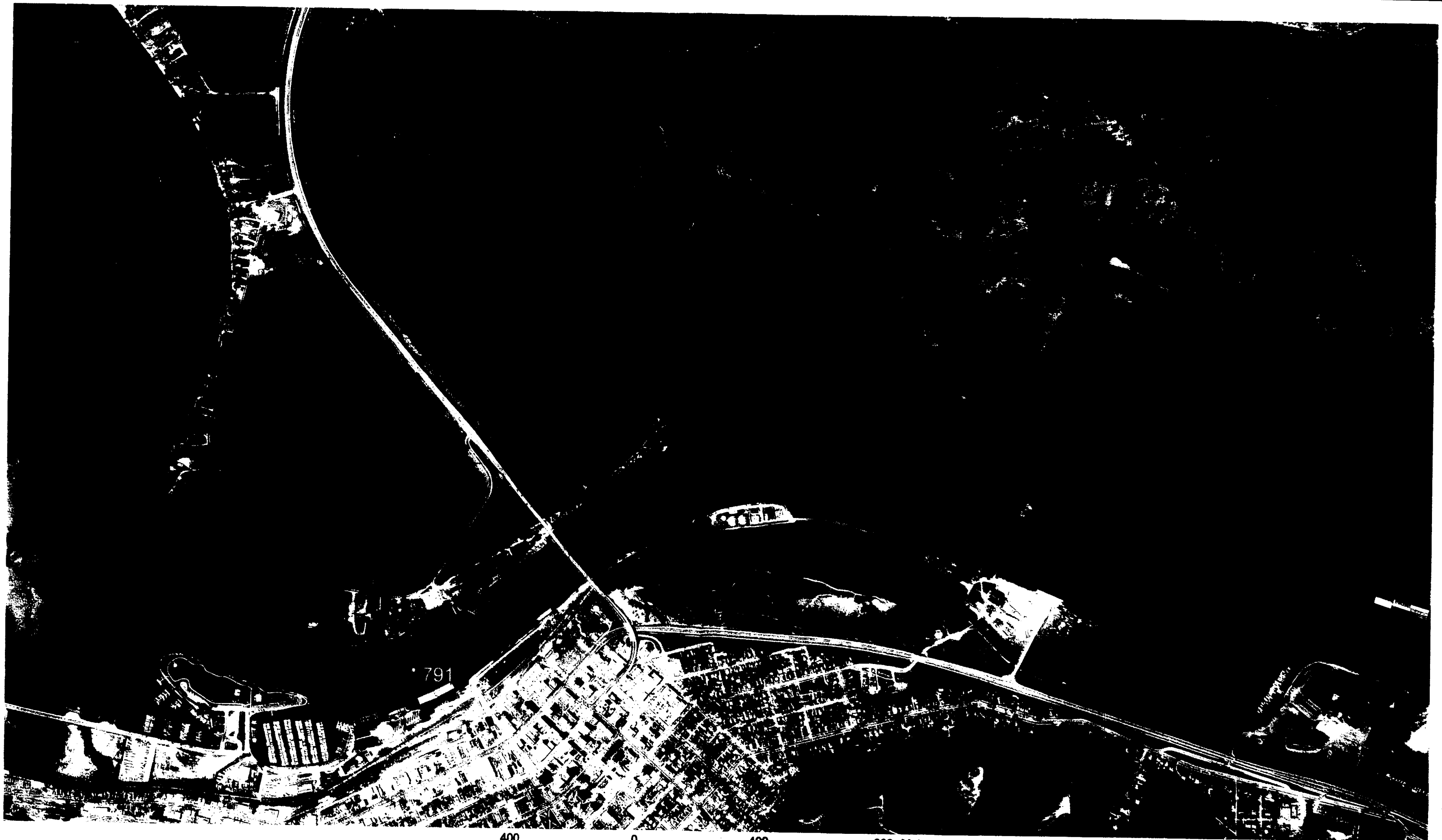
PLATE 13



POOL 4 DREDGE CUTS

Image Data: USGS Digital Orthophoto - 7 May 1992

PLATE 14



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US Army Corps of Engineers

POOL 4 DREDGE CUTS

Image Data: USGS Digital Orthophoto - 7 May 1992

PLATE 15

St. Paul District
GIS CENTER
US Army Corps
of Engineers

400 0 400 800 Meters
1000 0 1000 2000 Feet

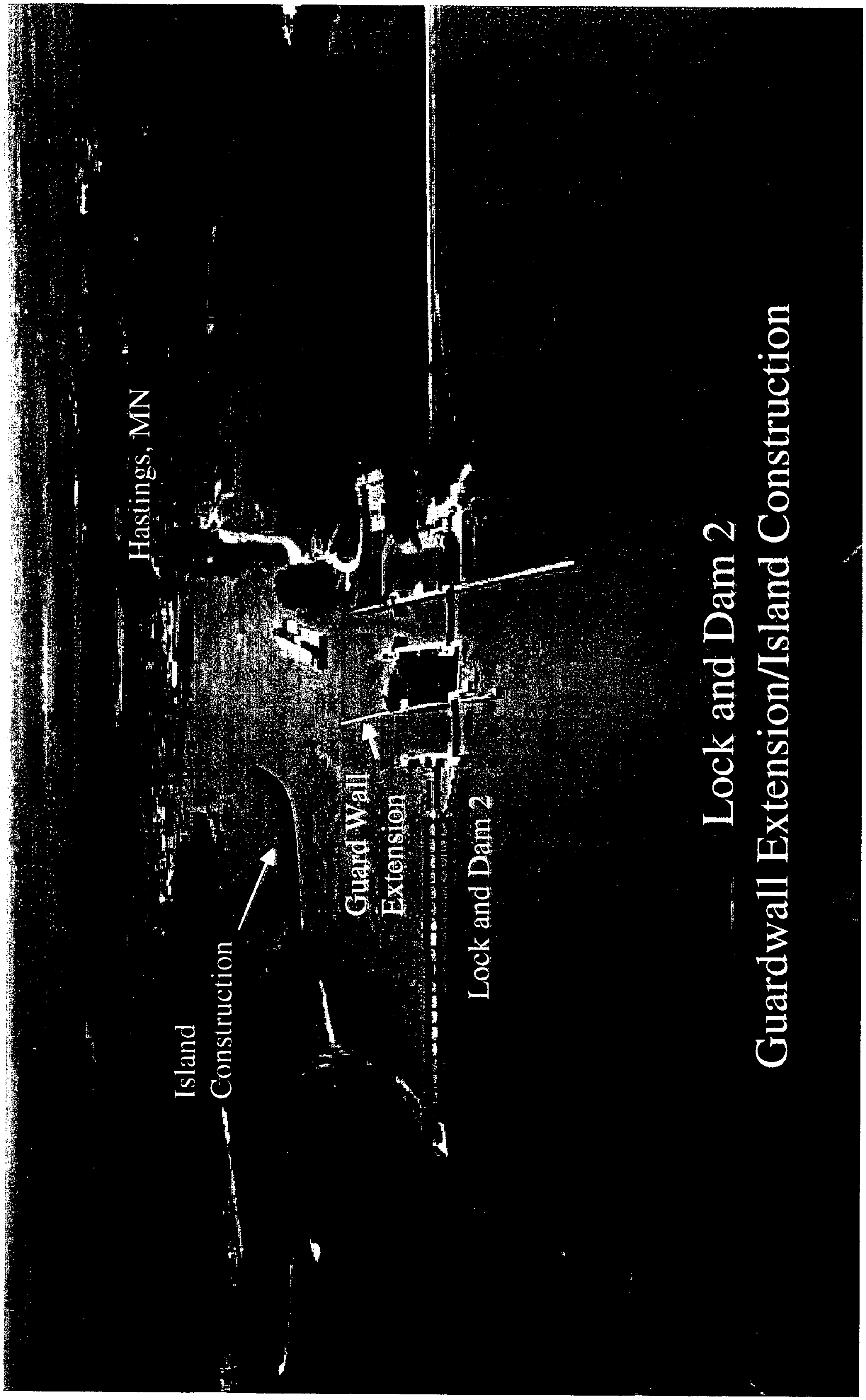
POOL 4 DREDGE CUTS

Image Data: USGS Digital Orthophoto - 7 May 1992

N W E S

River Mile
Wingdam
Dredge Cuts 1970 - 1979
Dredge Cuts 1980 - 1989
Dredge Cuts 1990 - 1995

PLATE 16

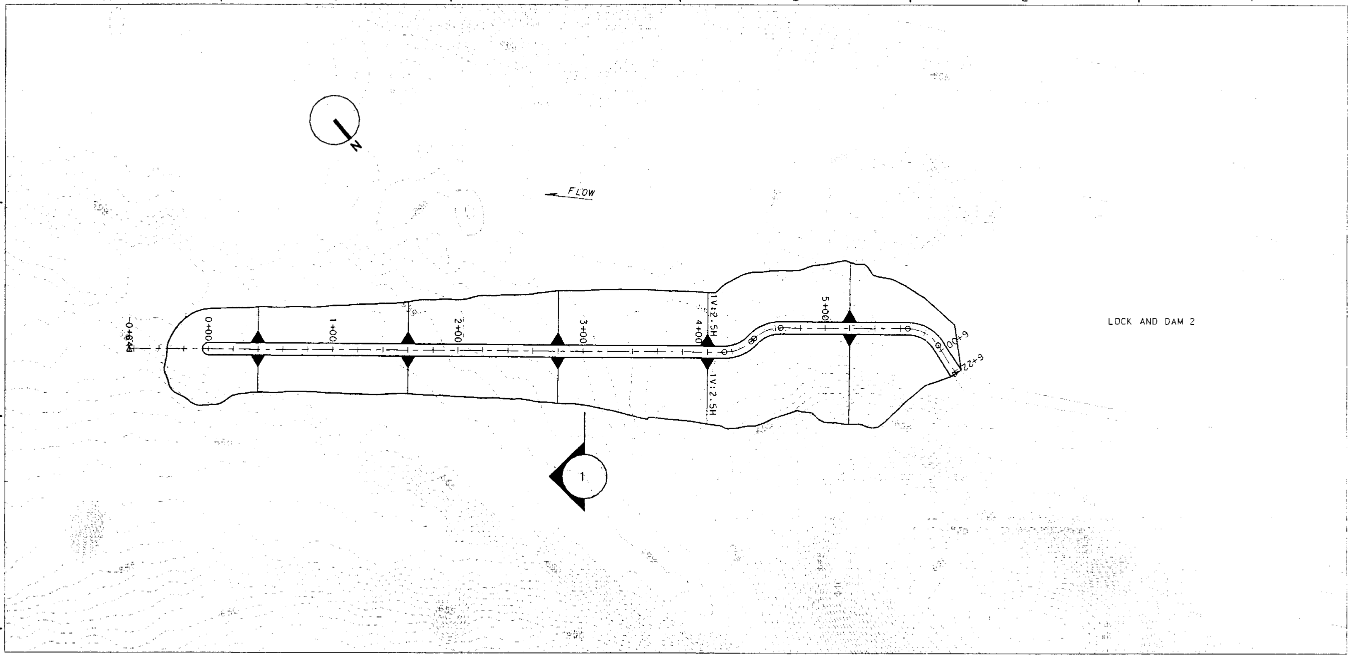


Hastings, MN
Island Construction
Guard Wall Extension
Lock and Dam 2
Lock and Dam 2
Guardwall Extension/Island Construction

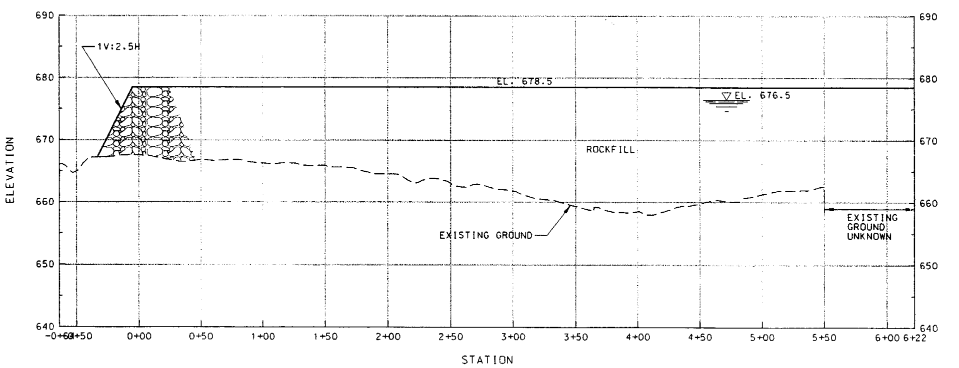
Plate 17

NOTES:

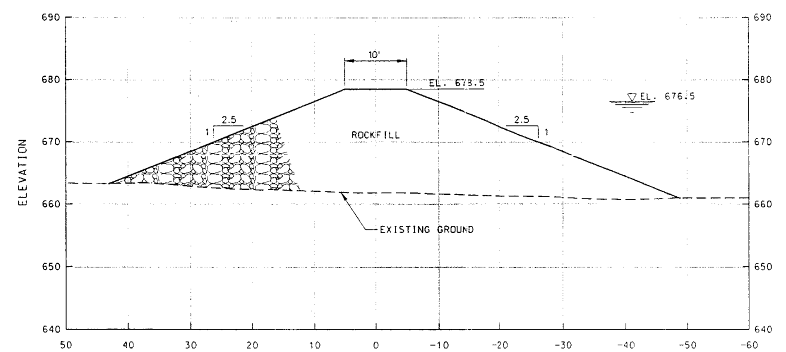
1. ONE FOOT CONTOUR INTERVAL USED.
2. ALL ELEVATIONS REFER TO MEAN SEA LEVEL (N.G.V.D. 1912 ADJ.).



PLAN
LD2 GUARDWALL EXTENSION
50 0 50 100
SCALE IN FEET



STATION
PROFILE
LD2 GUARDWALL EXTENSION



TYPICAL SECTION (1)
LD2 GUARDWALL EXTENSION
SCALE: AS SHOWN

US Army Corps of Engineers
St. Paul District

Description | Date | Appr.

DESIGNED: JJF/JGS
CHECKED:
DRAWN: JGS
DESIGNED: JSH
CHECKED:
SCALE: AS SHOWN
DATE: NOV 2 00
CADD FILE NAME: MSRC16101.DGN
SOL NO: DACW37-99-B-0000
AE APPROVING OFFICIAL

DEPARTMENT OF THE ARMY
ST. PAUL, MINNESOTA
CORPS OF ENGINEERS
ST. PAUL DISTRICT

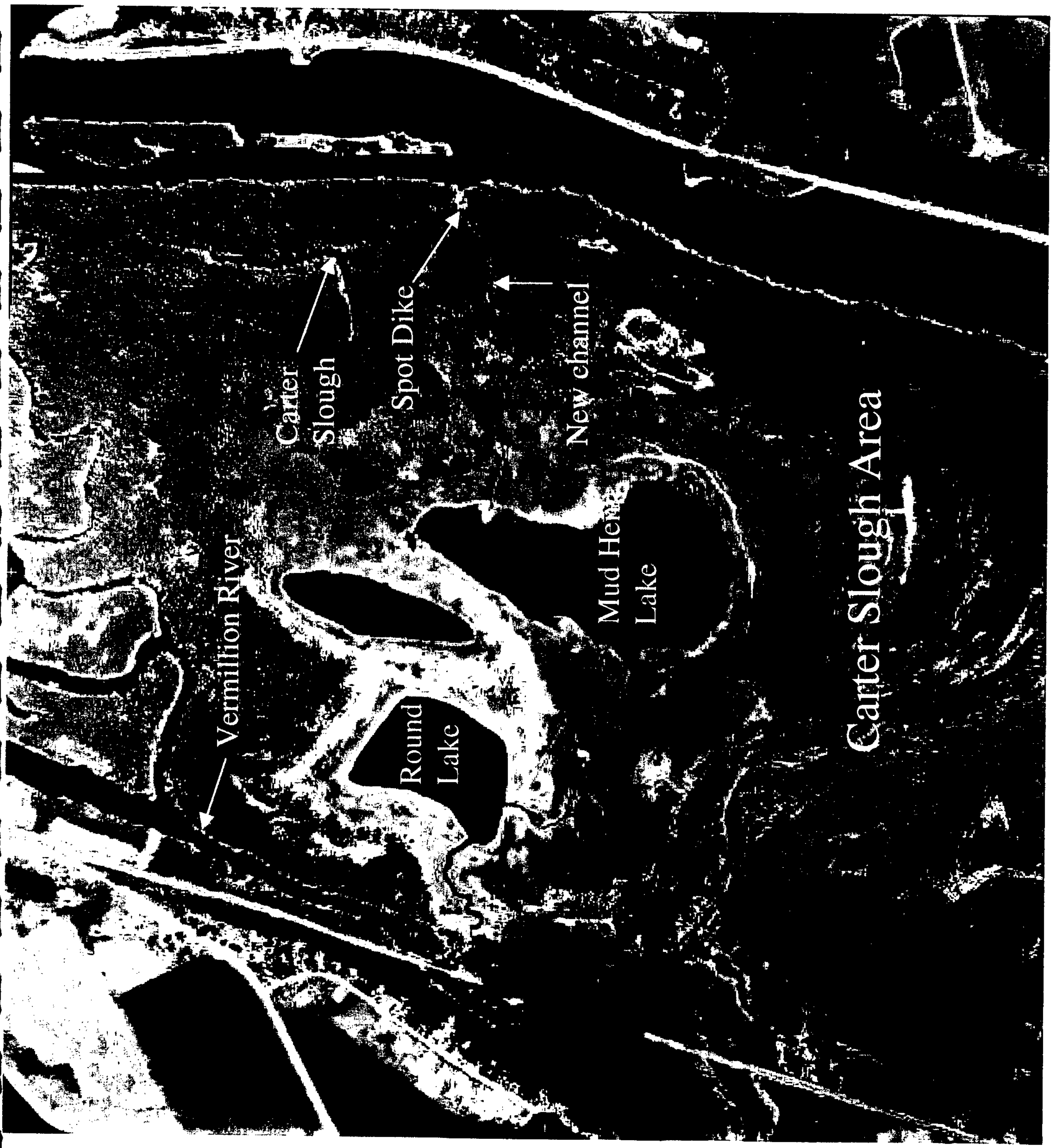
DPR

POOL 3/UPPER POOL 4 CMS
CHANNEL MAINTENANCE
LD2 GUARDWALL EXTENSION

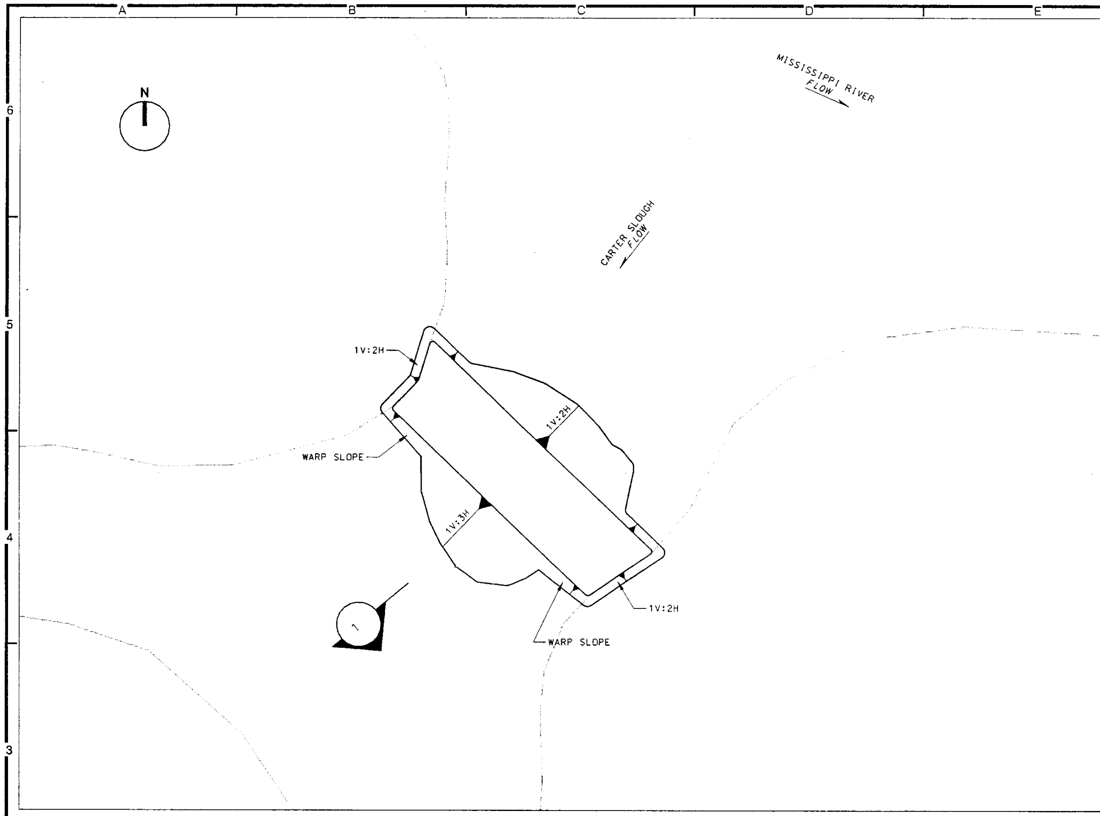
DRAWING NUMBER
M34-T-CC/FNO.01

Plate 18


Conley Lake
Hastings, Mn



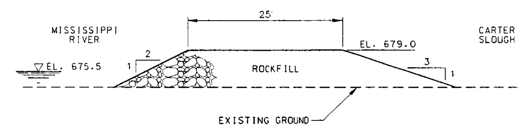
Carter Slough
Spot Dike
New channel
Vermilion River
Mud He
Lake
Round Lake
Carter Slough Area



PLAN
CARTER SLOUGH DIKE
20 0 20 40
SCALE IN FEET

NOTES:

1. DUE TO LACK OF BASE TOPOGRAPHY, LOCATION OF DIKE IS APPROXIMATE.
2. DIKE WILL BE APPROXIMATELY 6FT HIGH AT ITS TALLEST POINT.
3. ALL ELEVATIONS REFER TO MEAN SEA LEVEL (N.G.V.D. 1912 ADJ.).



TYPICAL SECTION
CARTER SLOUGH DIKE
SCALE: 1" = 10'
1

US Army Corps of Engineers
St. Paul District

Symbol	Description	Date	Appr.

DESIGNED: JJF/JGS | SCALE: AS SHOWN | DATE: NOV 2000
CHECKED: | CADD FILE NAME: M3RC16102.DGN
DRAWN: JGS | SOL NO: DACW37-99-B-0000
DESIGNED: JSH | AE APPROVING OFFICIAL:
CHECKED:
ED-D
ED-H

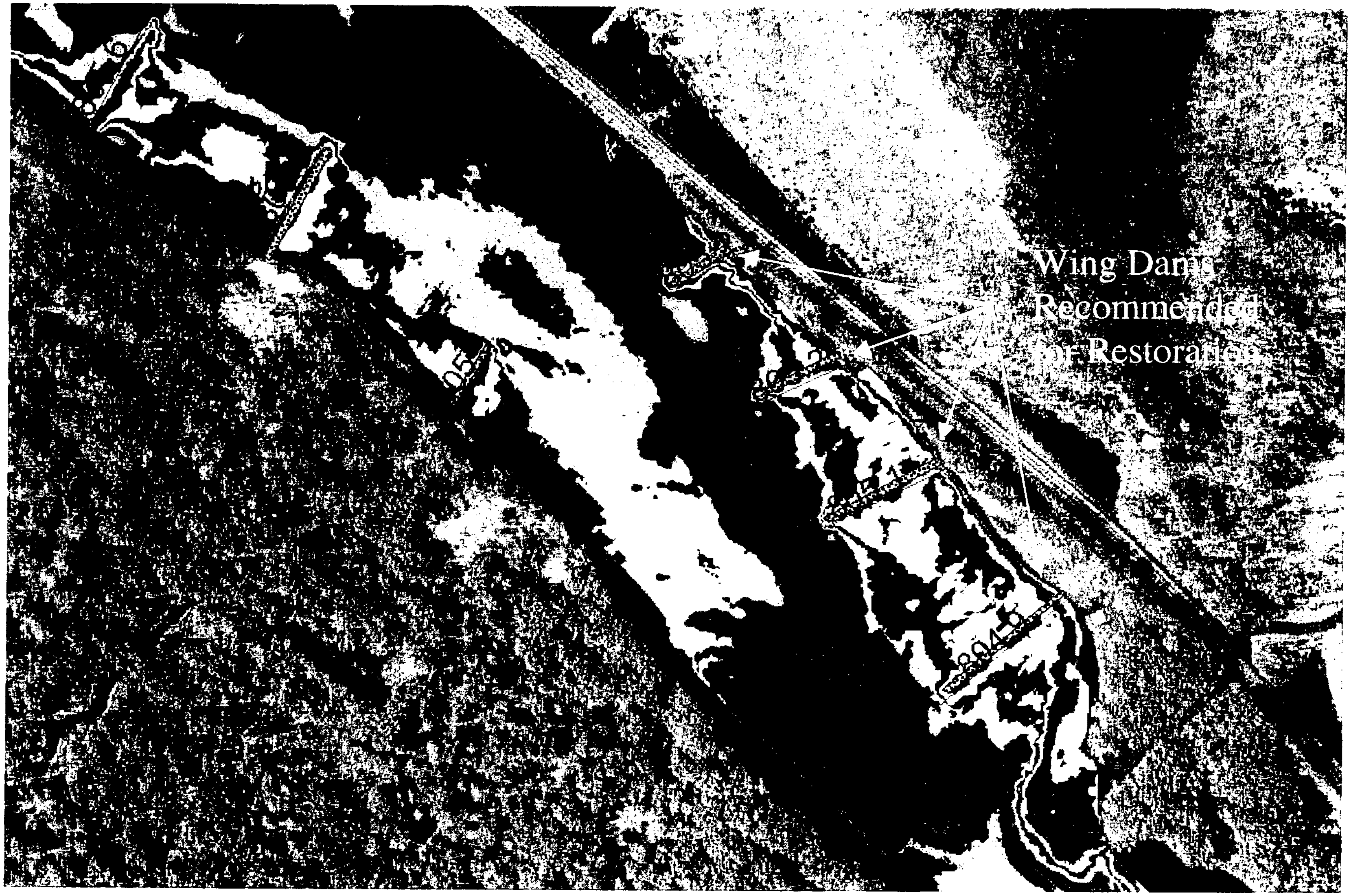
DEPARTMENT OF THE ARMY
ST. PAUL, MINNESOTA
CORPS OF ENGINEERS
ST. PAUL DISTRICT

DPR

POOL 3/UPPER POOL 4 CMS
CHANNEL MAINTENANCE
CARTER SLOUGH DIKE

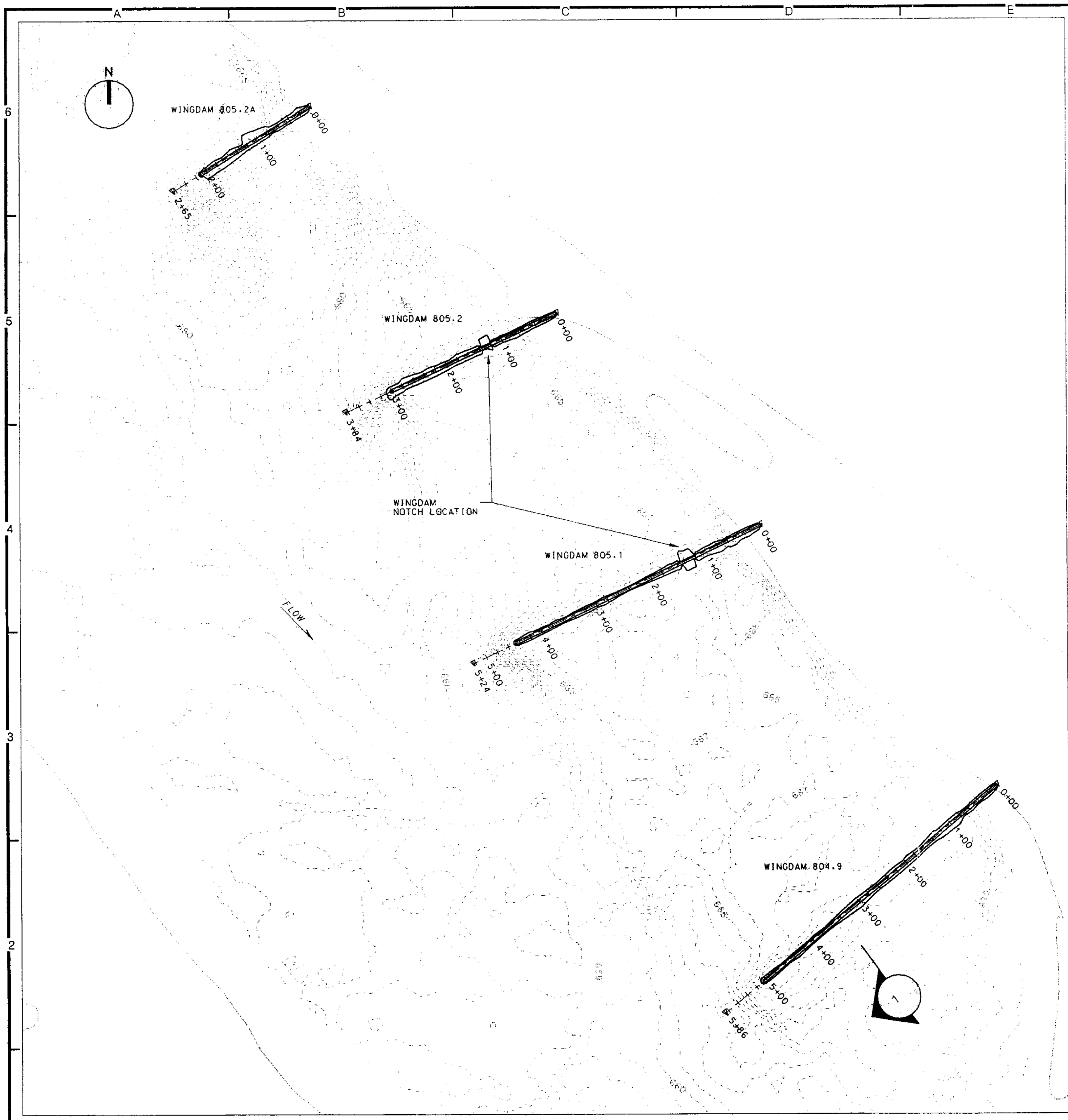
DRAWING NUMBER:
M34-T-CC/FNO.01

Plate 21



Big RiverWing Dam Restoration

300 0 300 600 Meters



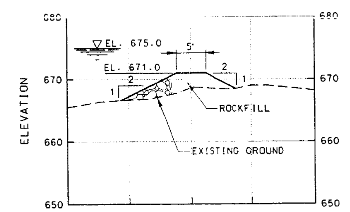
PLAN

BIG RIVER WINGDAM REHABILITATION

100 0 100 200
SCALE IN FEET

NOTES:

1. ONE FOOT CONTOUR INTERVAL USED.
2. ALL ELEVATIONS REFER TO MEAN SEA LEVEL (N.G.V.D. 1912 ADJ.).



TYPICAL SECTION

WINGDAM REHABILITATION
SCALE: AS SHOWN

US Army Corps of Engineers
St. Paul District

Symbol	Description	Date	Appr.

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CHECKED:	CADD FILE NAME: M3RC16103.DGN	
DRAWN: JCS	SOL NO: DACW37-99-B-0000	
DESIGNED: JSH	AE APPROVING OFFICIAL	
CHECKED:		

ED-D
ED-H

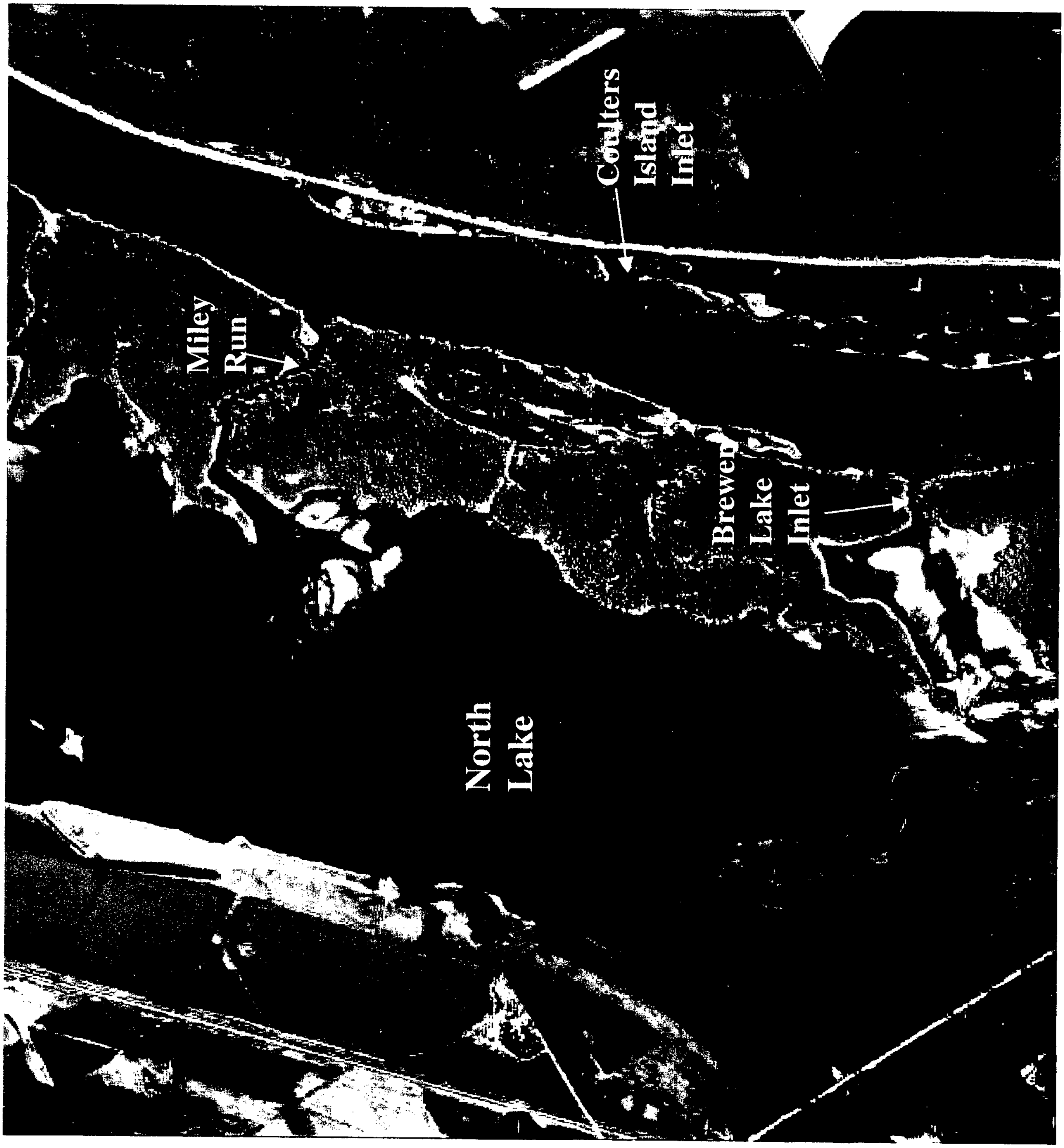
DEPARTMENT OF THE ARMY
ST. PAUL, MINNESOTA
CORPS OF ENGINEERS
ST. PAUL DISTRICT

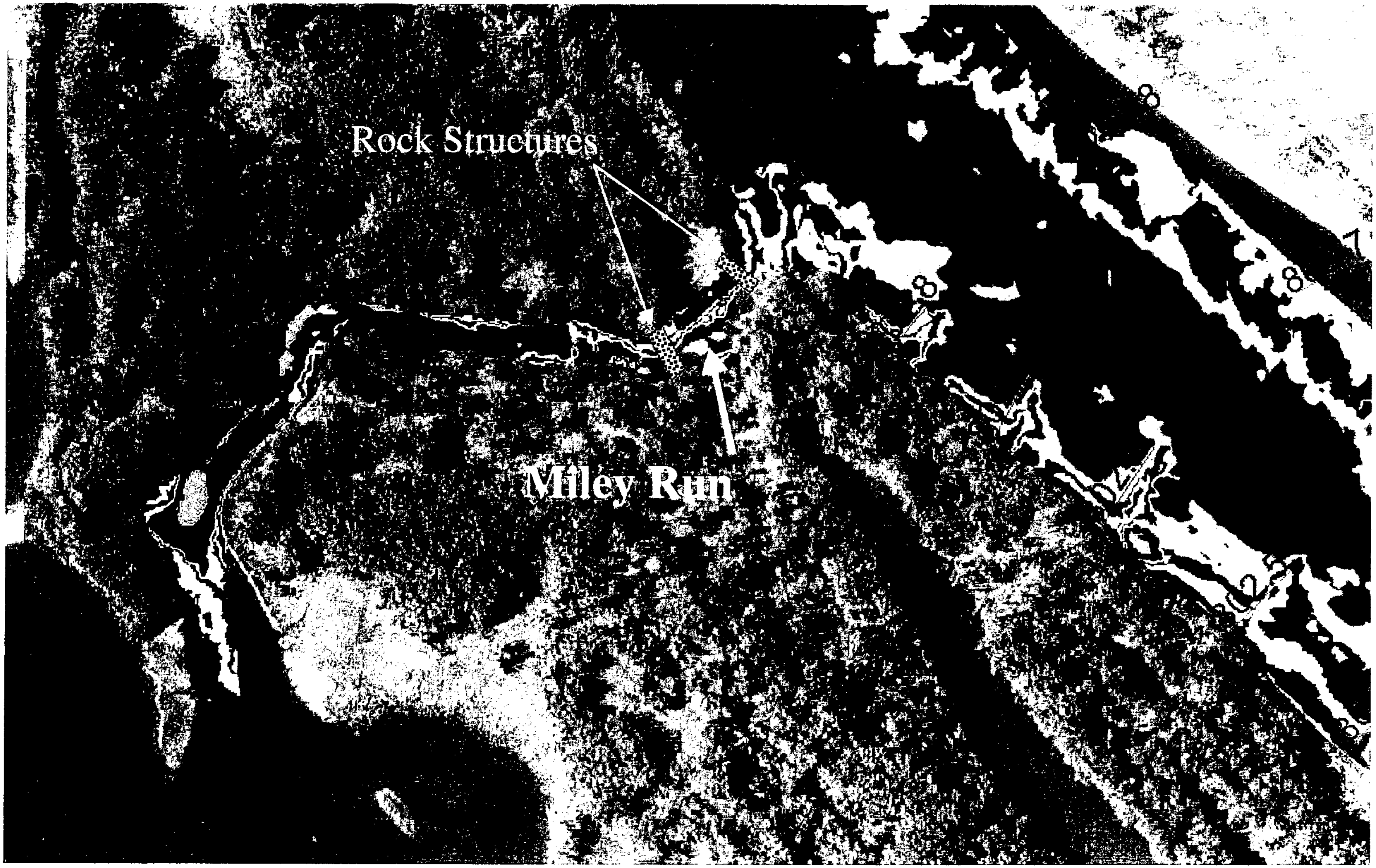
DPR

POOL 3/UPPER POOL 4 CMS
CHANNEL MAINTENANCE
BIG RIVER WINGDAM REHABILITATION

DRAWING NUMBER
M34-T-CC/FNO.01

Plate 23


Coulters Island Inlet
Miley Run
Brewer Lake Inlet
North Lake

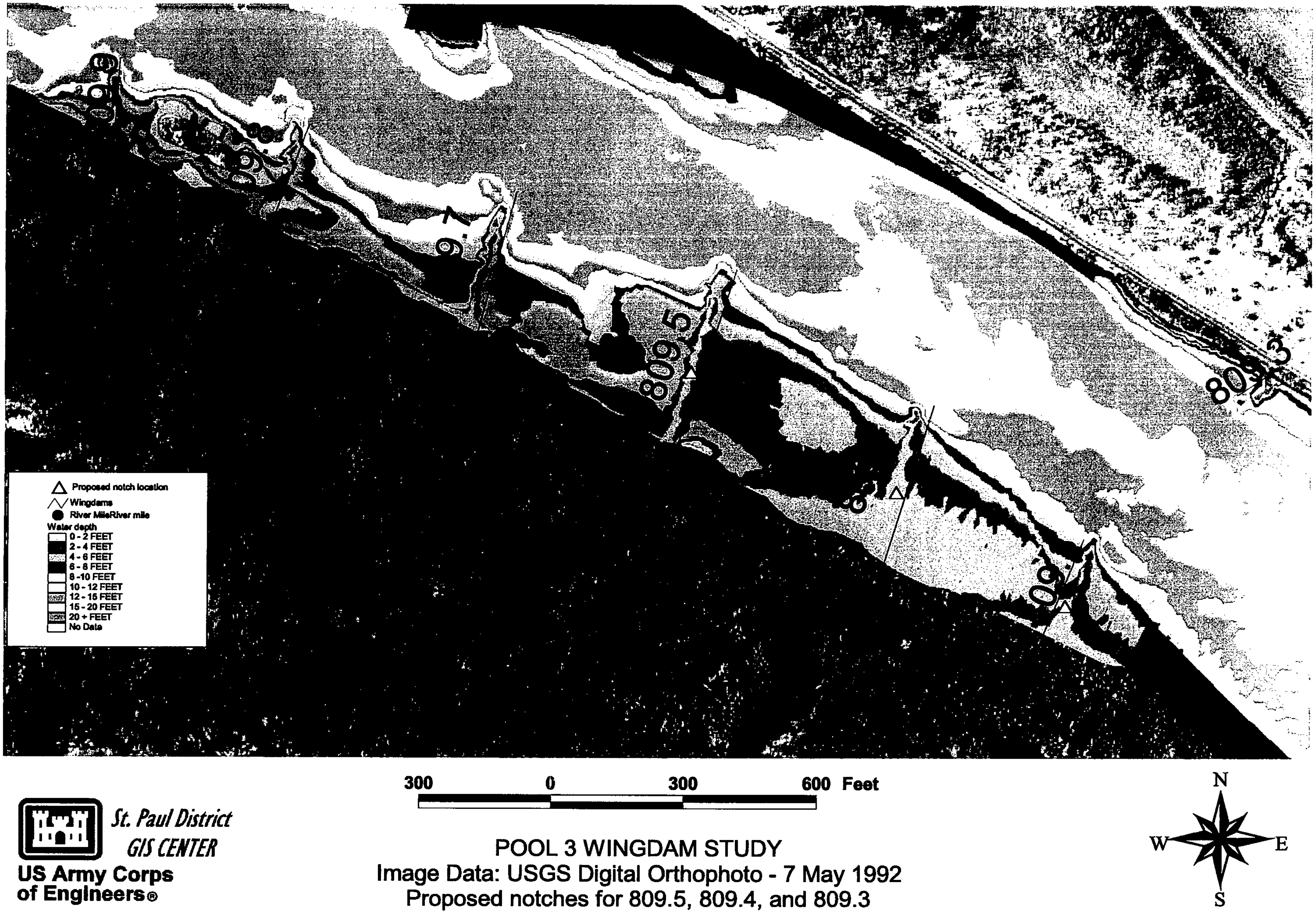


Miley Run Features

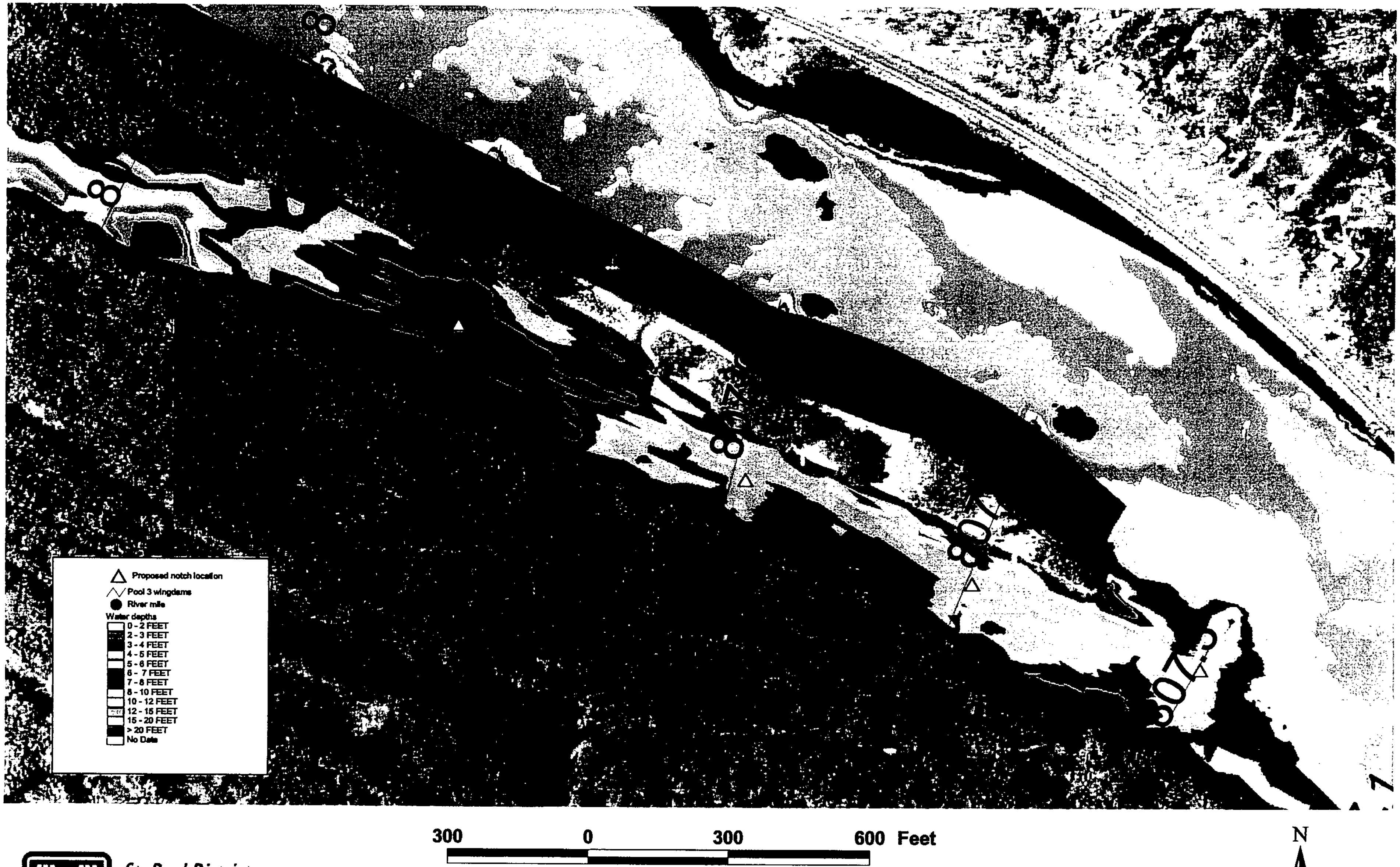
200 0 200 400 Meters

Brewer Lake Inlet/Coulters Island Inlet Features

300 0 300 600 Meters



POOL 3 WINGDAM STUDY
Image Data: USGS Digital Orthophoto - 7 May 1992
Proposed notches for 809.5, 809.4, and 809.3



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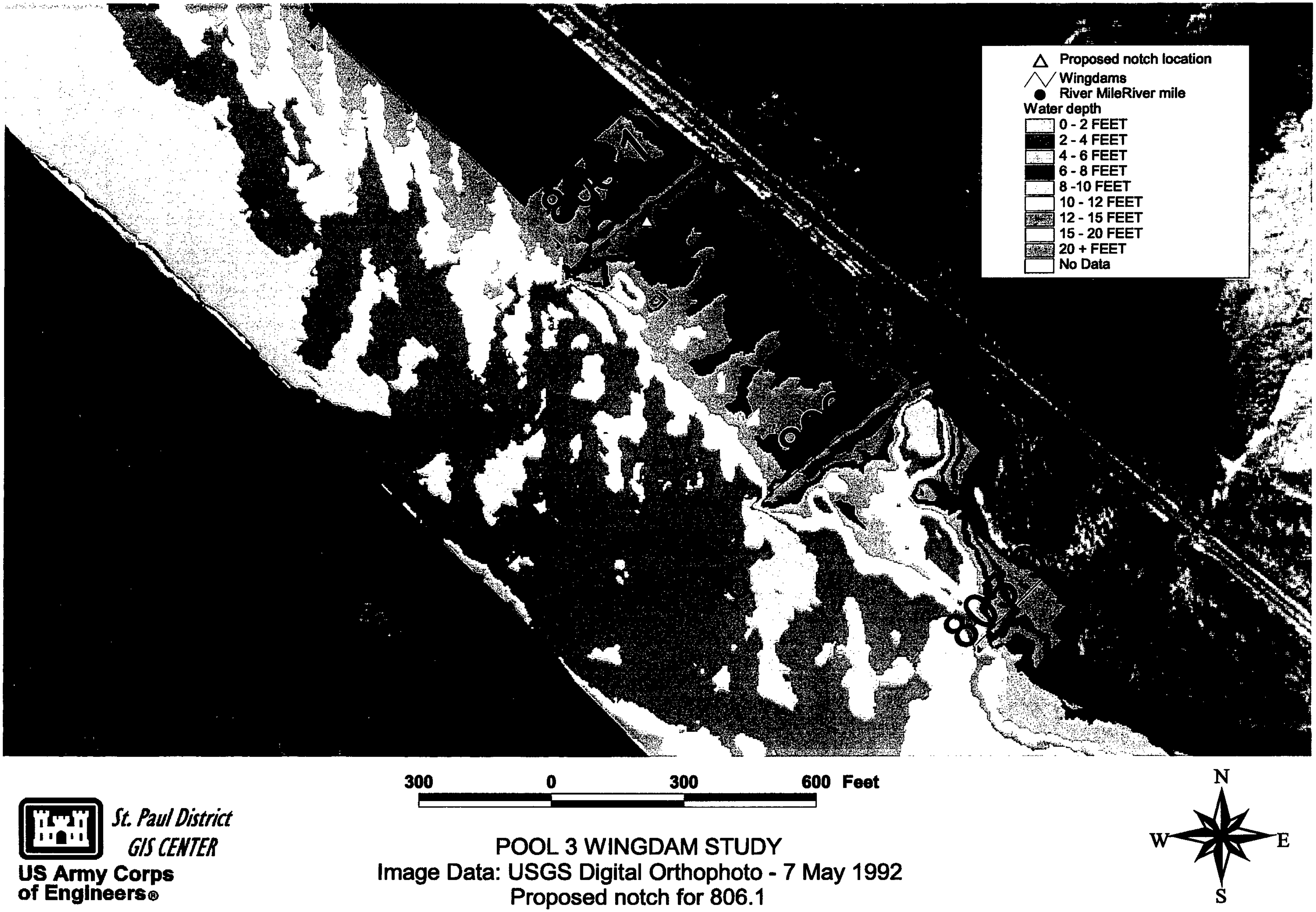
US Army Corps of Engineers®

POOL 3 WINGDAM STUDY
Image Data: USGS Digital Orthophoto - 7 May 1992
Proposed notches for 807.7, 807.6, 807.4, AND 807.3



POOL 3 WINGDAM STUDY
Image Data: USGS Digital Orthophoto - 7 May 1992
Proposed notch for 806.1

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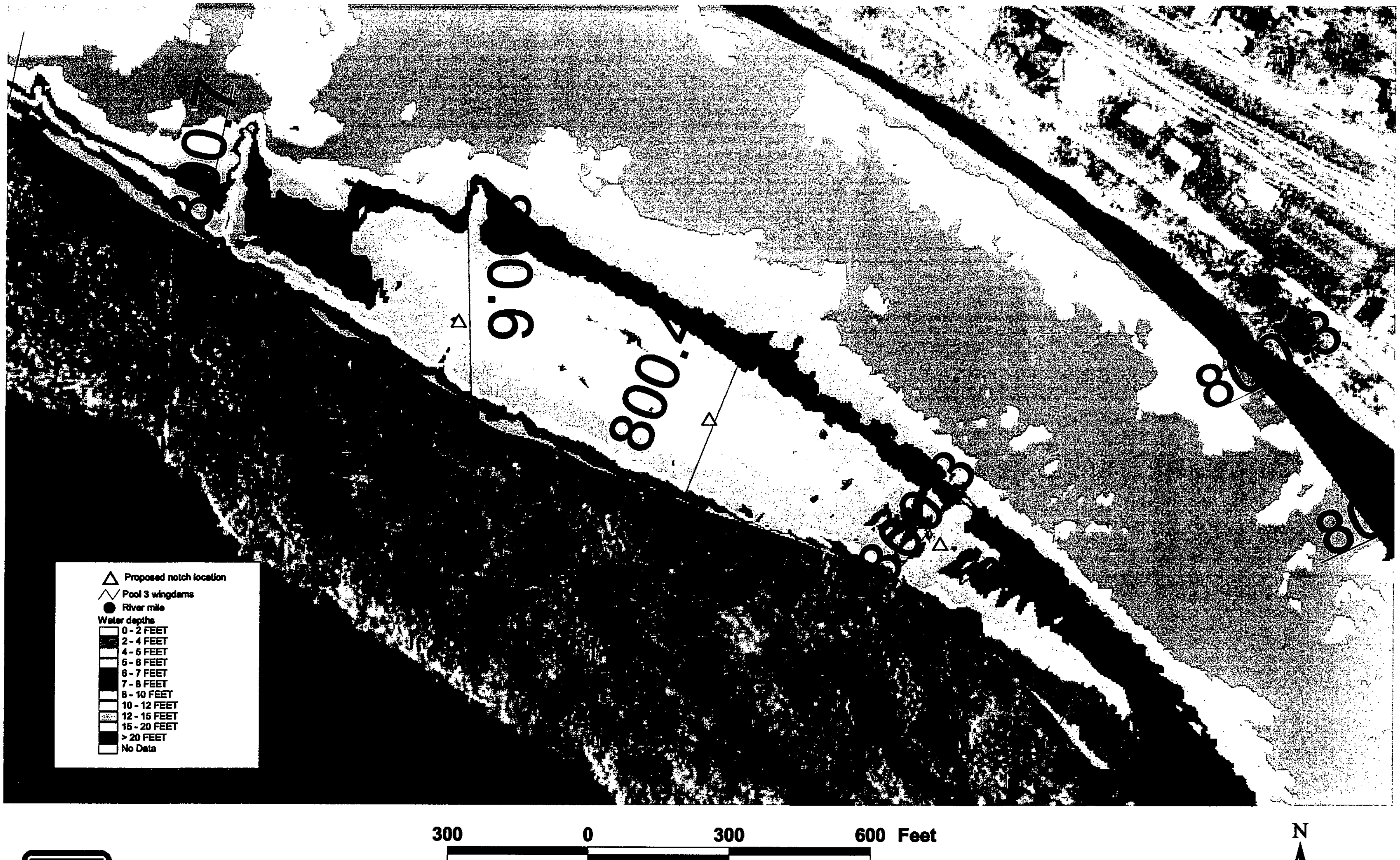
US Army Corps of Engineers®

POOL 3 WINGDAM STUDY
Image Data: USGS Digital Orthophoto - 7 May 1992
Proposed notches for 801.7, 801.6, and 801.4



St. Paul District
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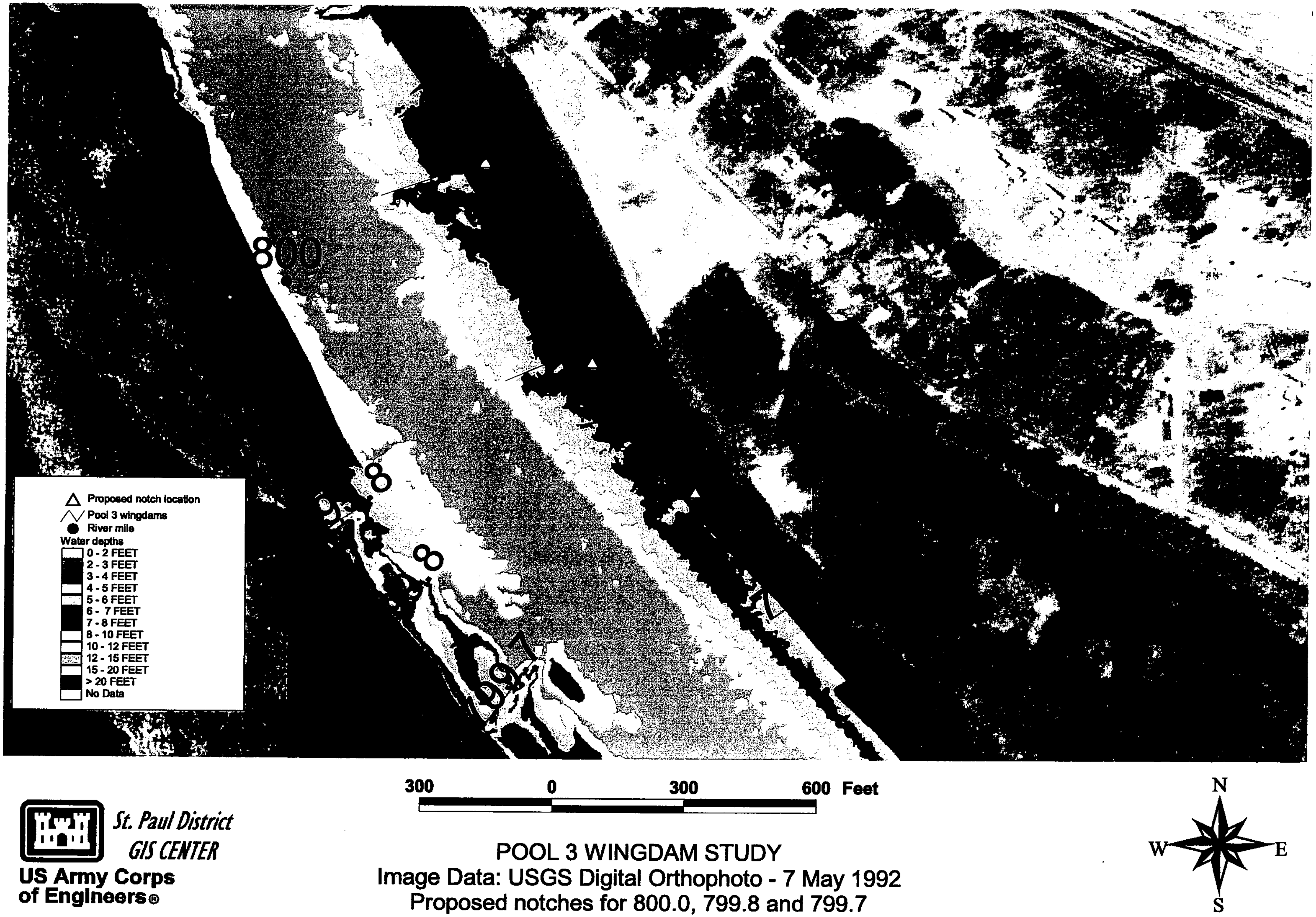
of Engineers®

POOL 3 WINGDAM STUDY
Image Data: USGS Digital Orthophoto - 7 May 1992
Proposed notches for 800.6, 800.4, and 800.3



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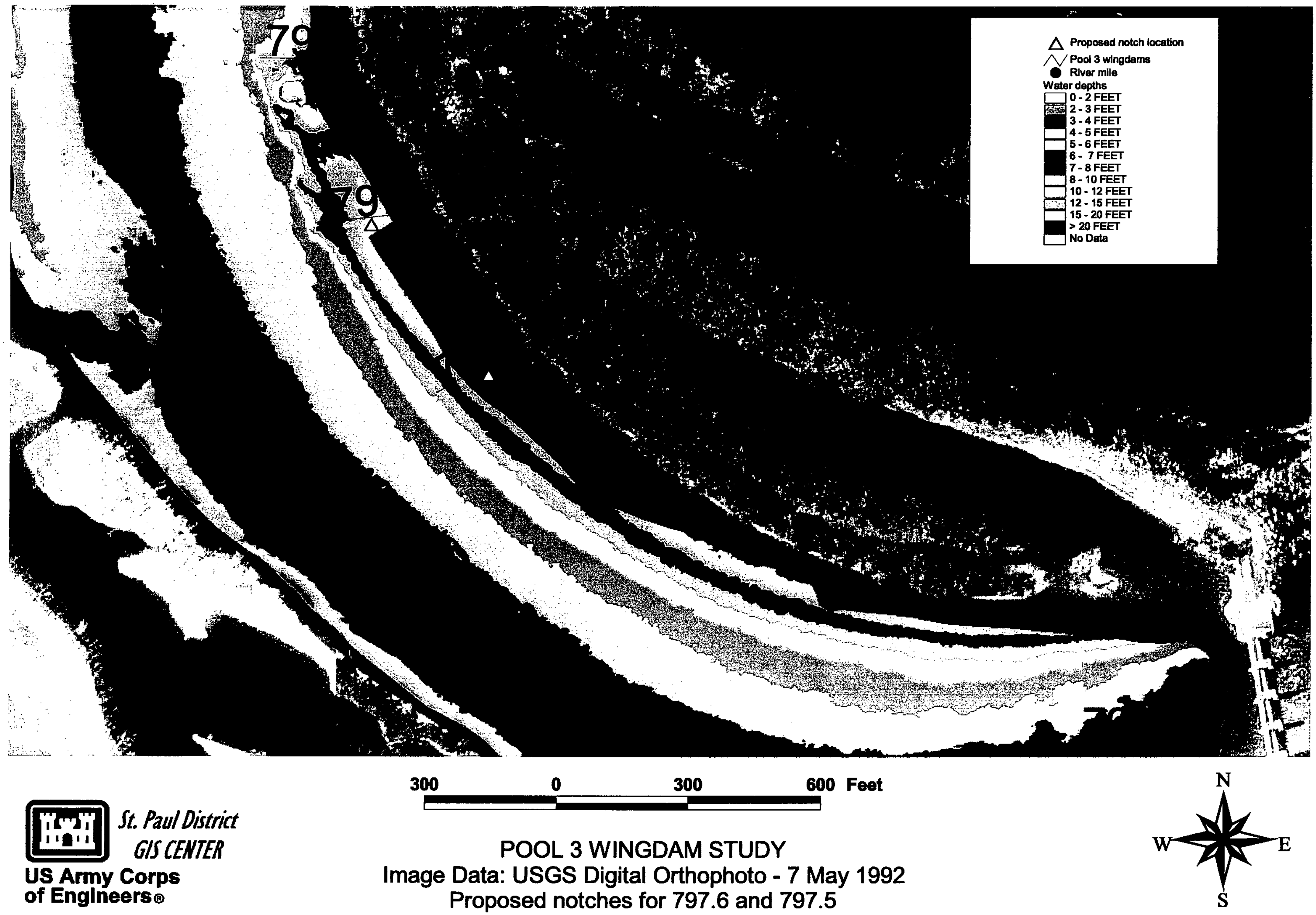
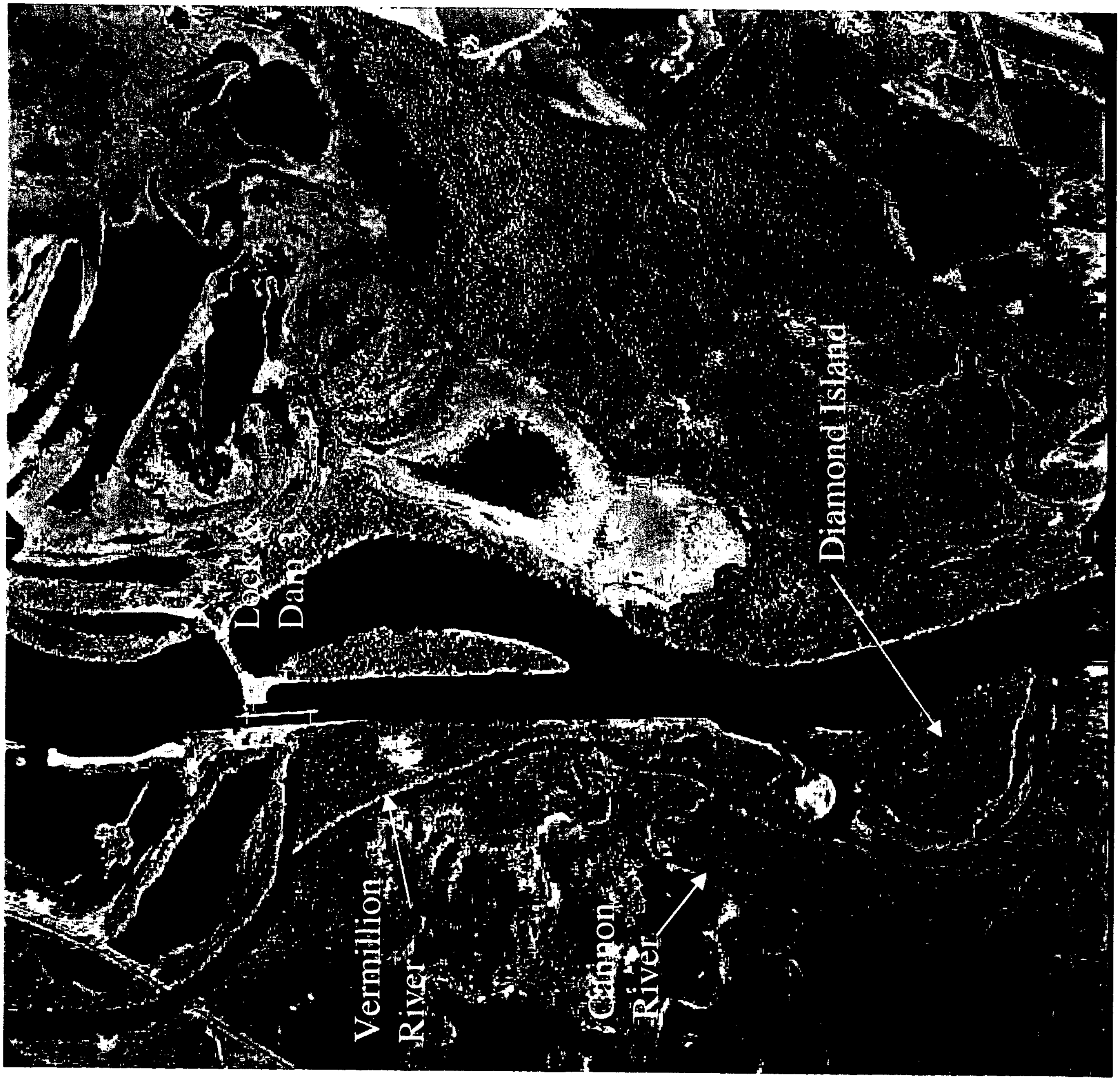
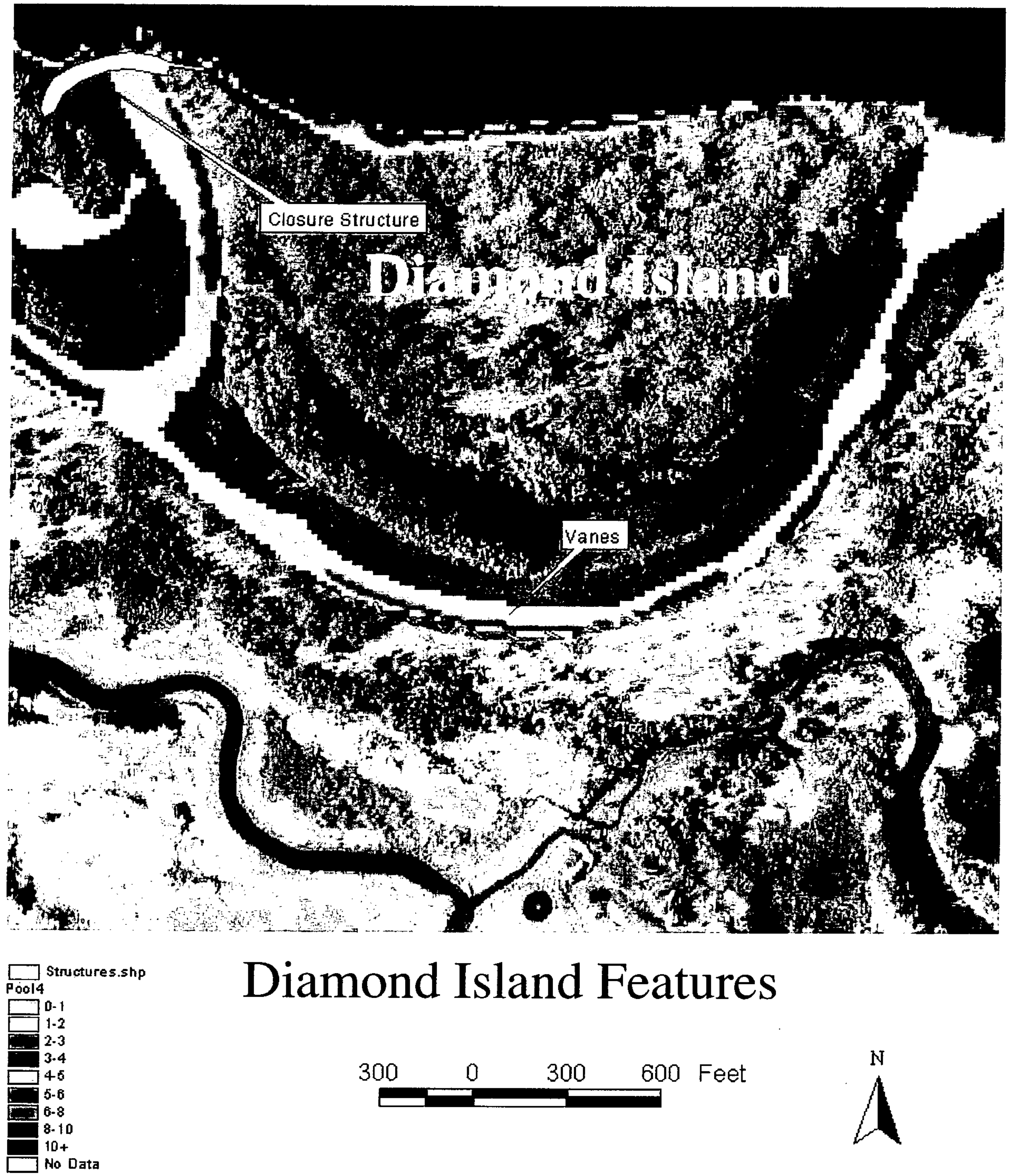
POOL 3 WINGDAM STUDY
Image Data: USGS Digital Orthophoto - 7 May 1992
Proposed notches for 800.0, 799.8 and 799.7



POOL 3 WINGDAM STUDY
Image Data: USGS Digital Orthophoto - 7 May 1992
Proposed notches for 797.6 and 797.5


Lock & Dam 3
Vermillion River
Cannon River
Diamond Island



Diamond Island Features

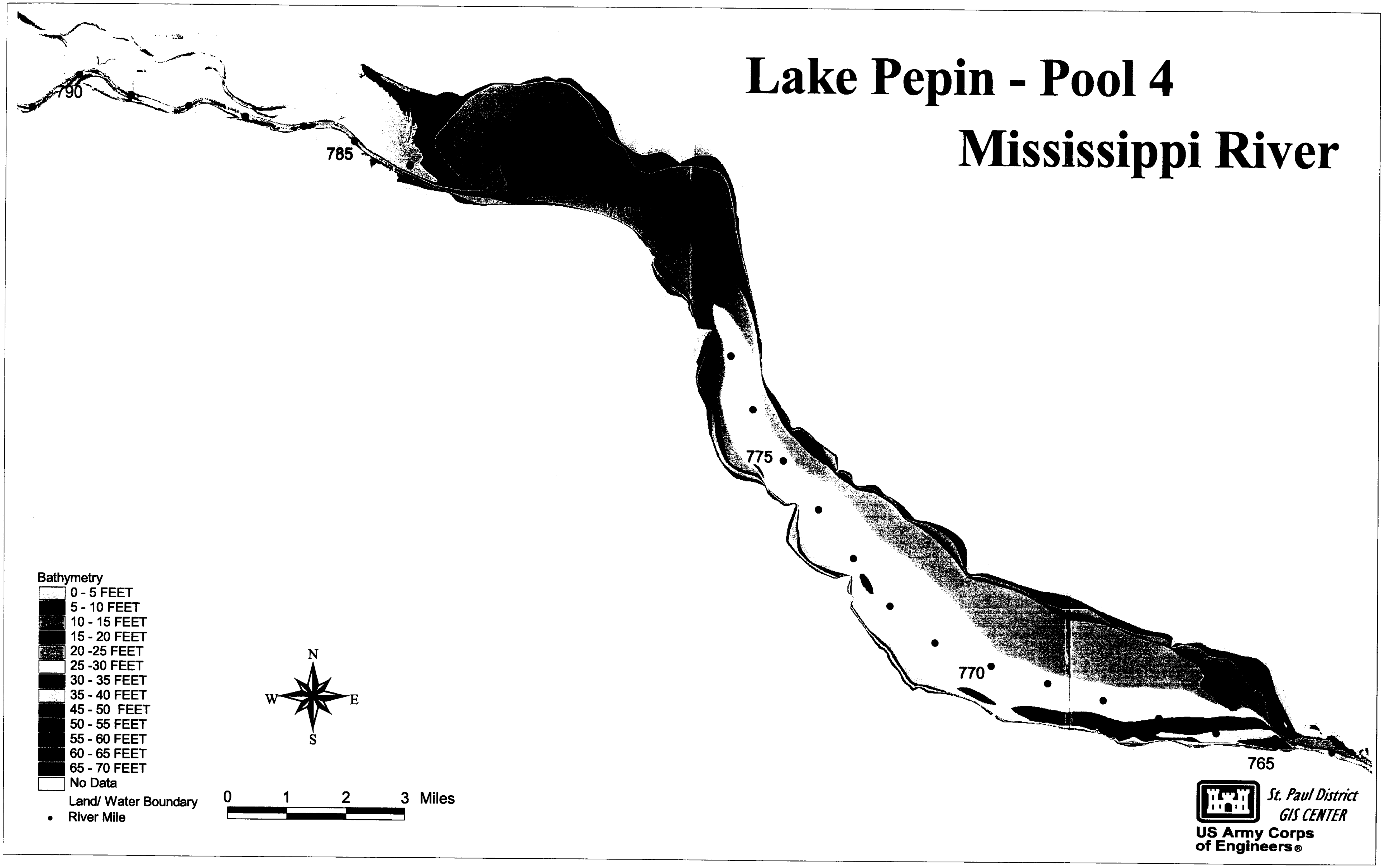

Lake Pepin - Pool 4
Mississippi River
790
785
775
770
765
Bathymetry
0 - 5 FEET
5 - 10 FEET
10 - 15 FEET
15 - 20 FEET
20 -25 FEET
25 -30 FEET
30 - 35 FEET
35 - 40 FEET
45 - 50 FEET
50 - 55 FEET
55 - 60 FEET
60 - 65 FEET
65 - 70 FEET
No Data
Land/ Water Boundary
River Mile
N
W
E
S
0
1
2
3 Miles
St. Paul District
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Plate 36

APPENDIX A

IHET Guidelines

INTERAGENCY HYDRAULIC EVALUATION TEAM

GOAL / OBJECTIVES / GUIDELINES

MAY 9, 1996

GOAL - Improve water and sediment management on the Upper Mississippi River so that a high quality riverine ecosystem is sustained, enhanced, or restored.

OBJECTIVE A - Establish guidelines so that hydrodynamic and sediment transport studies associated with future projects on the Upper Mississippi River:

- recognize the river as a continuous hydrologic and sediment transport system affecting the geomorphic and biologic attributes of the river.

- integrates all uses of the system, including fish and wildlife, commercial navigation, recreation, and riparian uses; so that mutually beneficial activities are pursued and sustainable multiple use is maintained while protecting ecological integrity.

- identify geomorphic trends so projects utilize hydrologic and sediment transport processes to produce desireable biologic and geomorphic responses .

- build on existing knowledge obtained through experience and research so that project design is optimized, understanding of the river is increased, and river management is improved.

OBJECTIVE B - Increase the understanding of Upper Mississippi River hydrodynamics, and sediment transport so that biologists, engineers, managers, and others can make better decisions regarding management of the river.

GUIDELINES FOR OBJECTIVE A

GUIDELINE 1 - Establish primary projects based on identified need or opportunity.

GUIDELINE 2 - Establish study area boundaries, and hierarchical subareas within the study area, based primarily on hydrodynamic and sediment transport processes affecting the primary projects and on project impacts. Flexibility should be built into study area boundaries so that adjustment can be made based on multiple use goals or if interim study results support reducing or expanding boundaries.

GUIDELINE 3 - Identify multiple use goals and opportunities in the study area such as those related to fish and wildlife habitat, navigation channel maintenance, and recreation. Hydrologic connectivity goals (ie. the amount of water exchange between backwater areas and the navigation channel) should be established. Identify goals and opportunities that are mutually beneficial. While funding and authority limitations may limit the ultimate project scope during construction, the study should transcend these limitations and consider all uses of the river.

GUIDELINE 4 - Develop a list of options for achieving goals emphasizing options that achieve multiple goals. Sustained ecological integrity and multiple use should be the primary factors considered in choosing options.

GUIDELINE 5 - The study process should expand on past experience and incorporate new ideas and research. The study should represent a building block for understanding the entire river system and ultimately for managing the river as an ecosystem.

GUIDELINE 6 - Riverine processes occurring in the study area, associated with hydrodynamics and sediment transport, should be identified and analyzed. Different levels of analysis can be used within subareas of the study area. If project impacts or riverine processes affecting the project are significant, hydrodynamic and sediment transport analysis should be quantitative, incorporating state of the art data collection and numerical or physical modeling (given the limits of existing knowledge and technology). Cumulative changes to the study area due to recent (ie. the last 20 years) activities should be quantified.

GUIDELINE 7 - Geomorphic trends in the river floodplain should be determined. Both the project study and past studies should be used to determine these trends.

GUIDELINE 8 - Identify opportunities for projects to work with desireable geomorphic trends and riverine processes to achieve environmental and economic sustainability.

GUIDELINE 9 - A system-wide integrated study approach should be adopted. Activities in adjacent reaches and tributaries, or changed system operation (ie. alternative water level management) should be considered.

GUIDELINE 10 - Develop a monitoring plan based on project impacts, whether methods used to analyze the project were qualitative or quantitative, and opportunities for obtaining new information. Not every project needs a comprehensive monitoring plan.

GUIDELINE 11 - Reversibility and adjustability should be included in project design so that changes or removal can be implemented if postproject monitoring indicates this need.

APPENDIX B

Cost Estimates

APPENDIX B

COST ENGINEERING

TABLE OF CONTENTS

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PROJECT DESCRIPTION	B-1
CONTINGENCY DISCUSSION	B-2
CONSTRUCTION METHODS	B-2
PROJECT COST ESTIMATE	B-3 thru B-7

APPENDIX B

COST ENGINEERING

GENERAL

1. This appendix contains a summary of the cost estimate prepared for the Pool 3/Upper Pool 4 Channel Management Study. This estimate includes; construction, planning, engineering, design and construction management costs. The estimate was developed after review of project plans, discussion with the team members, and historical costs for the River and Harbors crew. Guidance for the preparation of the estimate and attachments was obtained from ER-1110-2-1302 Civil Works Cost Engineering.

PRICE LEVEL

2. Project costs and contingencies are based on October 2000 prices unless noted otherwise. Estimated costs are considered fair and reasonable.

PROJECT DESCRIPTION

3. The study area is from the head of Lake Pepin upstream to Lock and Dam 2 at river mile 815.3. The project consists of several channel control structures to reduce or control dredging requirements, to provide a safer navigation channel and to reduce or eliminate adverse effects on river resources.

4. Adequate sites for riprap are generally available within a reasonable distance from the river. A rock supply contract will identify specific sources for riprap. Riprap unit price includes loading, hauling and placement.

5. Since it is unknown at this time which wingdams will have material left in-water for habitat and which wingdams will be used for shoreline stabilization, an average estimate for wingdam notching was based on 75% of wingdams to be used for in-water habitat and 25% of wingdams to be used for shoreline stabilization.

6. Since it is unknown at this time if all of the identified structures will be constructed together or as separate items, the estimates assumed mob & demob cost for each individual site based on approximately a day of travel to each site and a day of travel back from each site. If two or more sites are constructed together then mob & demob cost can be reduced.

CONTINGENCY DISCUSSION

7. After review of the project documents and discussion with the design team, contingencies were developed which reflect the uncertainties associated with each item. These contingencies are based on uncertainties in quantities, unit pricing, and items of work not defined or recognized at the time of design. Quantity and design uncertainties are assigned with input from designers while Cost Engineers will assign unit price uncertainties. The levels of uncertainty for the estimate will generally be as follows:

   A. Mob & Demob. The mob & demob estimate is based on starting at the Fountain City Service Base with one day of travel to and from each site. Since it is unknown if other higher priority work may interrupt this work the contingency is 50%.

   B. Riprap. Normal design contingencies are expected and normal contingency values should be used. Field surveys were done at most sites for riprap quantity computations. It is reasonable to set the overall contingency to 25%.

   C. Wingdam Notching. The features include several wingdams to be notched. Where the work is fairly well defined except if the material removed will be used for in-water habitat or shoreline stabilization, contingencies of 33% should be used. Where the quantity for the wingdam notching was assumed, contingencies of 50% are used.

   D. Planning, Engineering and Design. The estimate for this is based on a percentage of the construction cost with a contingency of 20%.

   E. Construction Management. The estimate for this is based on a percentage of the construction cost with a contingency of 20%.

CONSTRUCTION METHODS

8. Work of this project is standard marine civil works type construction that includes dredging and riprap placement. Standard industry practices will be used for all work items.

L/D 2 Lower Guide Dike 23-Oct-00

	Quantity		Unit Price	Amount	Contingencies Amount	Contingencies %	Total w/ Contingincies
600 foot guide dike							
Mob & Demob	JOB SUM		****	$6,400	$3,200	50%	
Riprap	18,520	CY	$35.00	$648,200	$129,600	20%	
Subtotal				$654,600	$132,800		$787,000
Plans & Specifications (4%)				$26,200	$5,200	20%	
Construction Management (2%)				$13,100	$2,600	20%	
Total Estimated Cost for 600 foot Guide Dike				$694,000	$141,000		$835,000

Carter Slough 1-Nov-00

	Quantity		Unit Price	Amount	Contingencies Amount	Contingencies %	Total w/ Contingencies
Dike w/o Culvert							
Mob & Demob	JOB SUM		****	$6,400	$3,200	50%	
Stripping	27	CY	$10.00	$300	$200	50%	
Geotextile	172	SY	$3.00	$500	$200	33%	
Riprap	432	CY	$35.00	$15,100	$3,000	20%	
Subtotal				$22,300	$6,600		$29,000
Access							
Snagging	JOB SUM		****	$6,400	$3,200	50%	
Access dredging	5,100	CY	$5.00	$25,500	$12,800	50%	
Subtotal				$31,900	$16,000		$48,000
Plans & Specifications (10%)				$5,400	$1,100	20%	$7,000
Construction Management (5%)				$2,700	$500	20%	$3,000
Total Estimated Cost for Carter Slough				$62,000	$24,000		$86,000

Assume 2 days for snagging operations for access
Assume snagging debris can be left nearby or on-site
Assumed quantity for access dredging

Big River Wingdam Rehabilitations 19-Oct-00

	Quantity		Unit Price	Amount	Contingencies Amount	Contingencies %	Total w/ Contingencies
Wingdam @ RM 804.9							
Mob & Demob	JOB SUM		****	$6,400	$3,200	50%	
Stripping	5	CY	$10.00	$100	$100	50%	
Geotextile	110	SY	$3.00	$300	$100	33%	
Riprap	326	CY	$35.00	$11,400	$2,900	25%	
Subtotal				$18,200	$6,300		
Plans & Specifications (10%)				$1,800	$400	20%	
Construction Management (5%)				$900	$200	20%	
Total Estimate for Wingdam @ RM 804.9				$20,900	$6,900		$27,800
Wingdam @ RM 805.1 (includes wingdam notch)							
Stripping	8	CY	$10.00	$100	$100	50%	
Geotextile	135	SY	$3.00	$400	$100	33%	
Riprap	228	CY	$35.00	$8,000	$2,000	25%	
Excavation of notch	27	CY	$10.00	$300	$100	25%	
Subtotal				$8,800	$2,300		
Plans & Specifications (10%)				$900	$200	20%	
Construction Management (5%)				$400	$100	20%	
Total Estimate for Wingdam @ RM 805.1				$10,100	$2,600		$12,700
Wingdam @ RM 805.2 (includes wingdam notch)							
Stripping	7	CY	$10.00	$100	$100	50%	
Geotextile	132	SY	$3.00	$400	$100	33%	
Riprap	246	CY	$35.00	$8,600	$2,200	25%	
Excavation of notch	6	CY	$10.00	$100	$0	25%	
Subtotal				$9,200	$2,400		
Plans & Specifications (10%)				$900	$200	20%	
Construction Management (5%)				$500	$100	20%	
Total Estimate for Wingdam @ RM 805.2				$10,600	$2,700		$13,300
Wingdam @ RM 805.2 (just upstream of previous wingdam)							
Stripping	6	CY	$10.00	$100	$100	50%	
Geotextile	103	SY	$3.00	$300	$100	33%	
Riprap	255	CY	$35.00	$8,900	$2,200	25%	
Subtotal				$9,300	$2,400		
Plans & Specifications (10%)				$900	$200	20%	
Construction Management (5%)				$500	$100	20%	
Total Estimate for Wingdam @ RM 805.2				$10,700	$2,700		$13,400
Total Estimated Cost for Big River Wingdams				**$52,000**	**$15,000**		**$67,000**

Wingdam Notching 15-Feb-01

	Quantity		Unit Price	Amount	Contingencies Amount	%	Total w/ Contingincies
Wingdam							
Mob & Demob	JOB SUM		****	$6,400	$3,200	50%	
Wingdam 809.5 notch	380	CY	$20.00	$7,600	$2,500	33%	
Wingdam 809.4 notch	136	CY	$20.00	$2,700	$900	33%	
Wingdam 809.3 notch	90	CY	$20.00	$1,800	$600	33%	
Wingdam 807.8 notch	185	CY	$20.00	$3,700	$1,200	33%	
Wingdam 807.6 notch	16	CY	$20.00	$300	$100	33%	
Wingdam 807.4 notch	54	CY	$20.00	$1,100	$400	33%	
Wingdam 807.3 notch	38	CY	$20.00	$800	$300	33%	
Wingdam 806.1 notch	129	CY	$20.00	$2,600	$900	33%	
Wingdam 801.7 notch	84	CY	$20.00	$1,700	$600	33%	
Wingdam 801.6 notch	35	CY	$20.00	$700	$200	33%	
Wingdam 801.4 notch	208	CY	$20.00	$4,200	$1,400	33%	
Wingdam 800.6 notch	82	CY	$20.00	$1,600	$500	33%	
Wingdam 800.4 notch	46	CY	$20.00	$900	$300	33%	
Wingdam 800.3 notch	63	CY	$20.00	$1,300	$400	33%	
Wingdam 800.0 notch*	*31*	CY	$20.00	$600	$300	50%	
Wingdam 799.8 notch*	*31*	CY	$20.00	$600	$300	50%	
Wingdam 799.7 notch*	*31*	CY	$20.00	$600	$300	50%	
Wingdam 797.6 notch	113	CY	$20.00	$2,300	$800	33%	
Wingdam 797.5 notch*	*113*	CY	$20.00	$2,300	$1,200	50%	
Subtotal				$43,800	$16,400		$60,000
Plans & Specifications (10%)				$4,400	$900	20%	
Construction Management (5%)				$2,200	$400	20%	
Total Estimated Cost for Wingdam Notching				**$50,000**	**$18,000**		**$68,000**

* Wingdam quantities in italics are assumed volumes
Assume wingdam notching of approximately 200 CY/day if left in-water for habitat
Assume wingdam notching of approximately 100 CY/day if used for shoreline stabilization
Assume 75% of wingdam notches are in-water habitat
Assume 25% of wingdam notches are used for shoreline stabilization
Assume Rivers & Harbors crew and equipment cost of $3,200/day
At $3,200 /day ÷ 200 CY/day = $16/CY unit cost if notches are used for in-water habitat
At $3,200 /day ÷ 100 CY/day = $32/CY unit cost if notches are used for shoreline stabilization

Average estimated unit cost of wingdam notching = (0.75)($16/CY) + (0.25)($32/CY) = $20/CY

Diamond Island Side Channel Restoration 23-Oct-00

	Quantity		Unit Price	Amount	Contingencies Amount	Contingencies %	Total w/ Contingencies
Diamond Island Closure							
Mob & Demob	JOB SUM		****	$6,400	$3,200	50%	
Stripping	64	CY	$10.00	$600	$300	50%	
Geotextile	493	SY	$3.00	$1,500	$500	33%	
Riprap	3,802	CY	$35.00	$133,100	$26,600	20%	
Subtotal				$141,600	$30,600		$172,000
Diamond Island / Vermillion River Vanes							
Access dredging	19,980	CY	$5.00	$99,900	$20,000	20%	
Riprap	198	CY	$35.00	$6,900	$1,400	20%	
Subtotal				$106,800	$21,400		$128,000
Plans & Specifications (10%)				$24,800	$5,000	20%	$30,000
Construction Management (5%)				$12,400	$2,500	20%	$15,000
Total Estimated Cost for Diamond Island				$286,000	$60,000		$346,000

APPENDIX C

Hydraulics Appendix

Pool 3/Upper Pool 4 Channel Management Study
Hydraulics Appendix

Introduction

Table C-1 lists the river reach, the problems identified in each reach, and the proposed river modifications in Pool 3 and Upper Pool 4 that were studied in detail as part of the hydraulics analysis.

Table C-1.	
Reach by River Miles	Problem/Proposed River Modification
814.2 – 815.2	Outdraft problem at Lock and Dam 2 and degraded channel habitat on the left side of the main channel / construct dikes or islands to improve conditions
806.9,805.9,804.8	Navigation problems created by navigation channel bends at these three tributaries / realign channel with training structures or by dredging
807.2	Carter Slough erosion has caused increases in the amount of water conveyed into Mudhen Lake/ A closure structure is needed to stabilize flow.
799.0 – 803.5	High dredging (often by more expensive mechanical dredge equipment) and degraded navigation conditions between RM 800.0 - 801.0 and 801.5 - 802.0/ shift dredging downstream by reducing secondary channel flow through the construction of riffle pool structures and rock sills in secondary channels. Riffle pool structures would improve aquatic habitat.
794.8 – 795.5	Diamond Island Back Channel – Sediment deposition has occurred in this channel/ A structure is needed to reduce the amount of sand that enters the channel and the channel needs to be restored.

Existing Conditions

Temporal Trends in Dredging – Figure C-1 shows annual dredging for five year time periods in pool 3 and Upper Pool 4 going back to 1941. The extremely high rates of dredging in the 1940s were probably due to the destabilizing effects of lock and dam construction. The high rates of dredging that occurred in the 1960s and 70s resulted in an oversized channel and is one of the factors causing the low rates of dredging in the late 1970s and early 1980s and the upward trend in dredging since. Table C-2 shows that there is an upward trend in dredging for both pool 3/upper 4 and the St. Paul District overall. However, the rate of increase in Pool 3/Upper 4 exceeds the rate of increase for the district. Table C-3 shows an analysis of the correlation between hydrology and dredging. This was done by dividing the average annual dredging by the average river discharge at lock and dam 3 for the five year time periods. Although there is an upward trend in average discharge, the increase in dredging is significantly higher. The bottom line is that dredging is increasing in Pool 3 and will probably stabilize at a level higher than what has been typical over the last 20 years, most likely between 50,000 and 100,000 cubic yards per year.

Figure C-1: Annual dredging volumes in Pool 3 and Upper Pool 4 for five-year time periods.

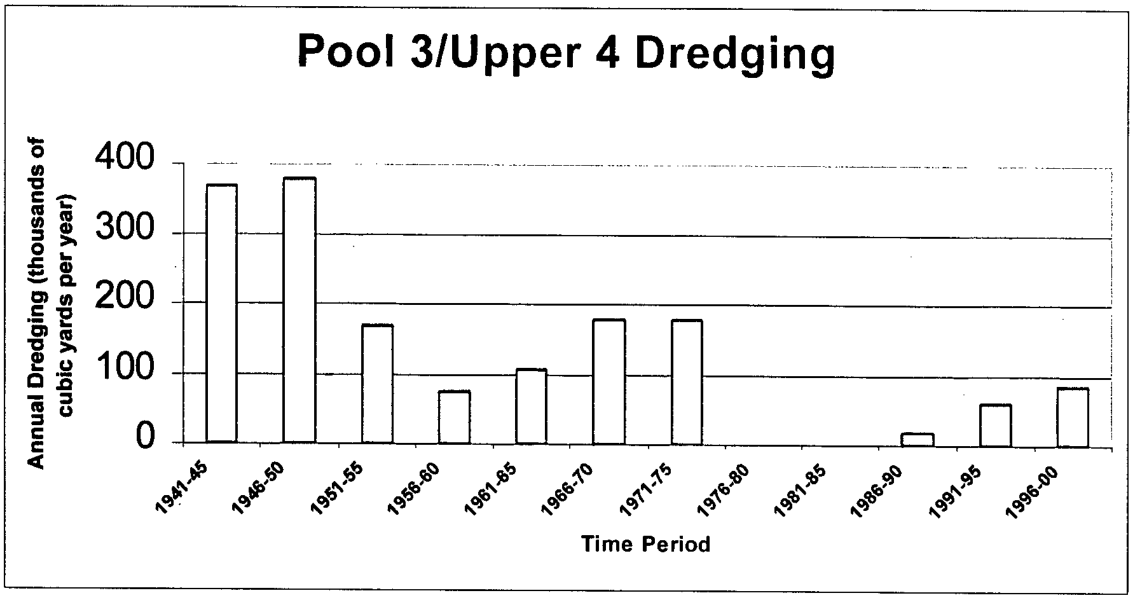


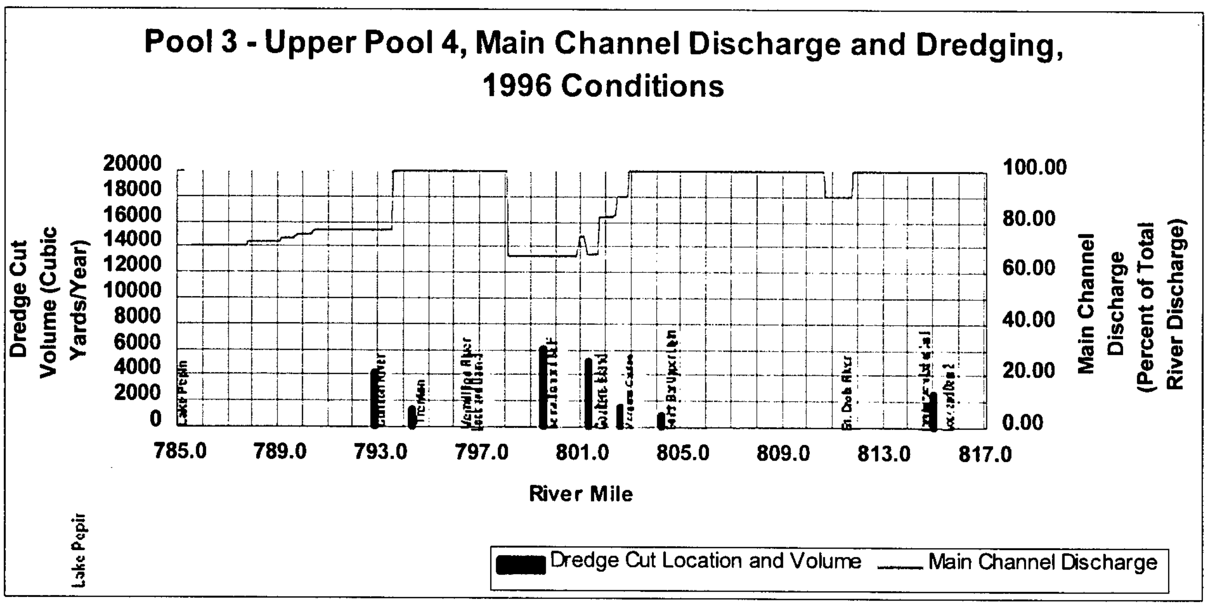
Table C-2. Ratio of Pool 3/Upper 4 Dredging to Average Dredging District-Wide			
Time Period	Pool 3/Upper 4 Dredging (cubic yards/year)	St. Paul District Dredging (cubic yards/year)	Ratio: Pool 3/ 4 Dredging to District Dredging
1976-1980	0	499,000	0
1981-1985	0	851,000	0
1986-1990	17,000	654,000	.025
1991-1995	60,000	870,000	.069
1996-1999	85,000	1,035,000	.082

Table C-3. Ratio of Pool 3/Upper 4 Dredging to Average Annual Discharge at Lock and Dam 3.			
Time Period	Average Annual Dredging (cubic yards/year)	Average Discharge (cubic feet/second)	Dredging to Discharge Ratio
1976-1980	0	15,600	0
1981-1985	0	24,200	0
1986-1990	17,000	16,800	1.0
1991-1995	60,000	26,600	2.2
1996-1999	85,000	24,300	3.5

Spatial Trends in Dredging – Prior to the 1970s dredging occurred throughout Pool 3 and Upper 4. Since this time, most of the dredging has occurred in the middle reach of Pool 3, at the Coulters Island and Diamond Bluff dredge cuts, and at the Cannon River cut in Upper Pool 4.

Spatial Trends in Hydraulics and its Effects on Dredging – Figure C-2 is a plot of dredging and main channel discharge (given as percent of the total discharge) by river mile. Main channel discharge is fairly high throughout the study reach, however like in many other reaches of the St. Paul District, there is a strong correlation between the location of dredge cuts and decreases in main channel discharge. The three largest dredge cuts, Coulters Island, Below Diamond Bluff, and Cannon River all occur where the main channel discharge has dropped to 75-percent or lower. Other factors affecting dredging include structures such as the lower approach to Lock and Dam 2, and tributaries such as the Cannon River.

Figure C-2: Dredging and main channel discharge versus river mile.



Temporal Trends in Hydraulics and its Effects on Dredging – Discharge measurements were obtained in 1991 as part of the North and Sturgeon Lake habitat projects and in late 1998 and early 1999 as part of this study. Table C-4 summarizes the size (based on percent of the total river discharge conveyed in 1991 and in 1998/99) and stability based on a comparison of 1991 to 1998/99 data. A 25-percent duration total river discharge of 28,500 cfs was used for reference. Based on the available data, Miley Run and the Brewers Lake Inlet have increased significantly in size causing the total flow conveyed through North and Sturgeon Lakes to increase from 29- to 43-percent of the total river flow. This is causing an increase in the amount of dredging at the Coulters

Island Dredge Cut and to a lesser extent at the Morgans Coulee Dredge Cut. Flow into the Vermillion Bottoms is relatively low for below bankful discharge, however it does increase substantially for flood events.

Table C-4. Secondary Channel Size and Stability. North and Sturgeon Lake Reach. A 25-percent duration total river discharge of 28,500 cfs is used as the reference discharge.

Site	1991 Discharge (Percent of Total River Discharge)	1998/99 Discharge (Percent of Total River Discharge)	Secondary Channel Stability
Truedale Slough (RM 808.5)	-	0.3	Stable
Carter Slough (RM 807.5)	-	0.3	Eroding
Jackson Run (RM 803.4)	3 Debris dam in 91	4.1 Debris dam in 98	Stable.
Miley Run (RM 802.9)	8.3 Debris affects flow	12.6 Debris affects flow	Eroding
Hardy Run (RM 802.2)	0 Debris dam in 91	0 Debris dam in 98	Stable.
Brewers Lake Inlet (RM 801.7)	7.8	15.7	Eroding
Sturgeon Lake Inlet (RM 800.9)	8.1	8.4	Stable
Inlet at RM 799.8	1.8	1.8	Stable
Total Flow to North & Sturgeon Lake	29.0	42.6	

Proposed Conditions

The following is a discussion of proposed conditions. A two-dimensional model (RMA-2V) was used to determine the impacts of several of the proposed project features. This model was developed by WEST Consultants Inc., and the Polaris Group Inc. Four different alternatives were modeled at three different discharges. Alternative 4 in the WEST report is the preferred alternative and is the one described in this appendix. Please refer to the WEST report (attached) for further details on the modeling that was done. The following text describes the project features and the physical effects of project features.

For the outdraft problem at the lower approach to Lock and Dam 2 and the degraded channel habitat on the left side of the main channel downstream of Lock and Dam 2, the following is proposed.

River Modification	Elevation (1912 adj.)	Width (feet)	Side Slopes	Length (feet)
Lower Guard Wall Extension at L/D 2, RM 815	Top Elev = 678.5	Top Width = 10	1V:2.5H	600
Barrier Island at RM 814.6	Top Elev = 678.5 Berm Elev = 677.5	Cross section description: 50' top width, 40' berm width, 1V:5H slope from top to berm.		1700
Channel through barrier island at RM 814.6	Bottom Elev = 673.0	Bottom Width = 20	1V:2.5H	-

Figure C-3 shows velocity patterns downstream of Lock and Dam 2. Figure C-4 shows changes in main channel velocities

Lower guard wall extension - The lower guard wall extension will reduce velocities in the lower approach to lock and dam 2, and will increase velocities in the main channel further downstream. The top elevation of 678.5 won't be overtopped for a discharge of 30,000 cfs, but will be overtopped by 2 to 2.5 feet of water for a discharge of 45,000 cfs.

Barrier Island – The barrier island reduces velocities in the shallow area on the west descending side of the navigation channel. The island cross section will be similar to those used at the pool 8, phase 3 islands. The top elevation of 678.5 won't be overtopped for a discharge of 30,000 cfs, but will be overtopped by 2 to 2.5 feet of water for a discharge of 45,000 cfs. There will be one channel through the barrier island located at the main shoreline. Shoreline stabilization for the barrier island will consist of vanes spaced at 100 foot intervals on the channel side of the island, an offshore rock mound (approximately 30 feet from the island shoreline) at the tip, groins spaced at 180 foot intervals on the interior, and vegetation throughout (Table C-5). The channel through the barrier island will be stabilized using 2 riffle pool structures. Given the shallow water depths in this area, excavation will have to be done to place the riffle pool structures. The riffle-pools are necessary since scour will occur on the downstream side of the structures after the island is in place.

Table C-5. Stabilization of the Barrier Island

Feature	Top Elevation	Top Width	Length	Side slope
Vanes	678.0 to 675.0	3'	40'	1V:2.5H
Offshore Mound	678.0	3'	200'	1V:2.5H
Groins	678.0	3'	30'	1V:2.5H
Riffle Pools	673.0	20'	= xsect perimeter	1V:2.5H

For Carter Slough the following is proposed

River Modification	Elevation (1912 adj.)	Top width (across channel)	Side Slopes	Length (upstream to downstream)
Spot dike	679.0	= channel width	1V:3H	20 feet

A single spot dike near the entrance of Carter Slough should be constructed. The elevation of this spot dike, 679.0, is below the typical bank elevations in this area and so during high water events, water will flow over the spot dike before it flows over the banks, relieving erosive forces on the bank. The spot dike will be overtopped for flows above approximately 45,000 cfs which is approximately a 1.5-year flood event. The cross section design for the spot dike can be similar to that in the Goose Lake HREP DPR, though a few changes are needed. These changes include, eliminating the sheetpile in the structure, eliminating the toe protection on the Mississippi River side of the structure, and increasing the top width to 20 feet.

For the navigation problems created by the bends at the three tributaries that enter from the Wisconsin side of the main channel, the following is proposed.

River Modification	Elevation (1912 adj.)	Width (feet)	Side Slopes	Length (feet)
Wing Dam Rehabilitation at RM 807.4, 807.6, and 807.8. Closure Structure at RM 807.8	Top Elev = 679.5	Top Width = 5	1V:2H	As shown on maps
Wing Dam Rehabilitation at RM 804.9, 805.1, 805.2, 805.2	Top Elev = 671.0	Top Width = 5	1V:2H	As shown on maps

Figures C-5 & C-6 show the spatial velocity distribution in the two reaches where wing dams are being modified.

Wing Dam Restoration at RM 807.4, 807.6, & 807.8, closure structure at RM 807.8 (Four Mile Island Reach) - The purpose of restoring these three wing dams where they cross the secondary channel is to reduce flow down the secondary channel and improve bathymetric diversity for fish habitat. The top elevation of 679.5 was chosen so that the structure will be slightly above water for a discharge of 45,000 cfs, which corresponds to about the bankfull discharge. The width of the channel between the end of the wing dam and the opposite shore is about 140 feet or about 22-percent less than the width of the narrowest section of the existing channel. Bank stabilization will probably be required for the opposite shore. A closure structure is included across the secondary channel at

river mile 807.8 so that flow is forced down the secondary channel instead of re-entering the river at this site. If it is decided to do wing dam notching in this reach, this will not significantly affect this project feature. Figure 4 shows the main channel velocity increase in this reach.

Wing Dam Restoration at RM 804.9, 805.1, 805.2, 805.2 (note: there are two wing dams labeled RM 805.2) - The purpose of restoring these wing dams is to improve the channel conditions for commercial navigation. Small notches will be included in the wing dam to create flow and bathymetric diversity. Figure C-4 shows the main channel velocity increase in this reach.

For the high dredging volumes and degraded navigation conditions between RM 800.0 - 801.0 and 801.5 - 802.0 dredging will be shifted downstream using the following method.

River Modification	Elevation (1912 adj.)	Width (across channel)	Side Slopes	Length (upstream to downstream)
Partial Closure at RM 801.7 (Brewer Lake Inlet)	Bottom Elev = 678.0	= channel width	1V:3H	20'
Channel through Brewer Lake Closure	Bottom Elev = 671.0	Bottom Width = 20'	1V:2.5H	
Rock Sill at RM 802.3	Bottom Elev = 671.0	= channel width	1V:3H	20'
Rock Sill at RM 802.9 (Miley Run)	Bottom Elev = 671.0	= channel width	1V:3H	20'
An alternative is to construct 30" thick channel liners on the Brewer Lake Inlet, Miley Run, Coulters Island, and Sturgeon Lake.	Varies with channel geometry	= channel width	1V:3H max	30'

Figure C-7 shows the spatial velocity distribution in this reach of river. Figure C-4 shows the increase in main channel velocity. These rock structures will be constructed to stabilize secondary channels and increase main channel flow. Our goal is to increase main channel velocities to a point where the majority of the coarse sediment entering this reach will be transported downstream to about river miles 799 to 800. This might be accomplished by increasing main channel velocities magnitudes so that they are similar

to velocity magnitudes in reaches in the upper portion of the pool. At river mile 801.7 (Brewer Lake Inlet) a single partial closure structure with a width of 20 feet and an elevation of 678.0 is proposed. A small channel will be left in the middle of the closure. At river mile 802.3 (the channel on the left side of the main channel) a rock sill with a bottom width of 20 feet is proposed. At river mile 802.9 (Miley Run) two rock sills are being considered to form a riffle pool complex. These sills have a minimum bottom elevation of 671.0. They are essentially rock liners in shallower areas, increasing the bottom elevation by approximately 4.5 feet.

This plan reduces discharge at Miley Run and the Brewers Lake Inlet, and increases inflows at the Sturgeon Lake Inlet and the Inlet at RM 799.8. Table C-6 gives the results in the middle reach of pool 3, from Jackson Run at RM 803.4 to the inlet at RM 799.8 . This basically amounts to returning flow distributions back to 1991 conditions.

Table C-6. Secondary Channel Discharge. North and Sturgeon Lake Reach.

Site	1991 Discharge (Percent of Total River Discharge)	1998/99 Discharge (Percent of Total River Discharge)	Proposed Conditions (Percent of Total River Discharge)
Jackson Run (RM 803.4)	3 Debris dam in 91	4.1 Debris dam in 98	3.7
Miley Run (RM 802.9)	8.3 Debris affects flow	12.6 Debris affects flow	10.0
Hardy Run (RM 802.2)	0 Debris dam in 91	0 Debris dam in 98	0.5
Brewers Lake Inlet (RM 801.7)	7.8	15.7	1.5
Sturgeon Lake Inlet (RM 800.9)	8.1	8.4	12.4
Inlet at RM 799.8	1.8	1.8	4.4
Total Flow to North & Sturgeon Lake	29.0	42.6	32.5

For the Diamond Island Back Channel, the following is proposed:

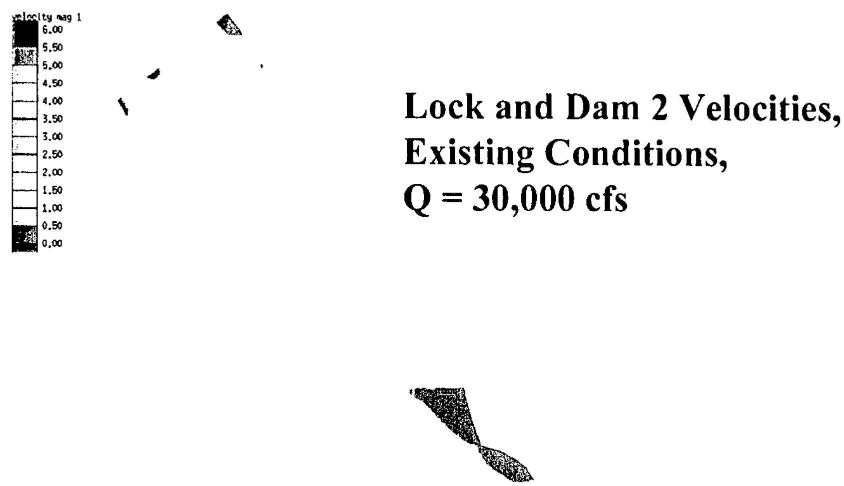
River Modification	Elevation (1912 adj.)	Width (across channel)	Side Slopes	Length (upstream to downstream)
Closure at head of Diamond Island channel	672.0	= channel width	1V:3H	20'
Vanes in Diamond Island channel	670.0 to 667.0	Top Width = 3'	1V:2.5H	Length = 30'

Closure Structure and vanes at the Diamond Island Channel at RM 794.8 to RM 795.5 – The purpose of the closure structure is to force the Cannon/Vermillion River to flow the entire length of the Diamond Island Channel and enter the Mississippi River at RM 794.8. The top elevation of the rock structure is 672.0, which is 2.5 feet higher than the average water surface of 669.5. During high flow events on the Mississippi River, a significant amount of water will flow over the closure structure. Since this water is from the top of the water column, it will have a lower sediment load than what currently enters the channel. A stable channel will eventually be formed by the Cannon and Vermillion River. Nine vanes approximately 100 feet apart should be constructed along the outside bend of the Diamond Island Channel to prevent bank erosion. The elevations of the vanes will be 670.0 at the river bank, and 667.0 at the end. The vanes will be effective during high flow events on the Cannon and Vermillion Rivers that occur when discharge is below average on the Mississippi River. That is why the elevation of the vanes is somewhat low.

Change in Water Surface Elevation for Project Features

Figure C-8 shows the increase in water surface elevation due to the various project features for a discharge of 45,000 cfs. This discharge corresponds to approximately the bankfull discharge and all of the project features are overtopped by river discharges higher than this. In addition, floodplain conveyance of water increases significantly as the river discharge rises above this level and the river banks are overtopped. As river discharge exceeds 45,000 cfs, the impacts of the project features on water surface elevations decreases. The increase throughout most of Pool 3 for a discharge of 45,000 cfs is approximately 0.1 feet. At Lock and Dam 2, the increase in water surface elevation approaches 0.2 feet.

Figure C-3. Lock and Dam 2 Velocities.



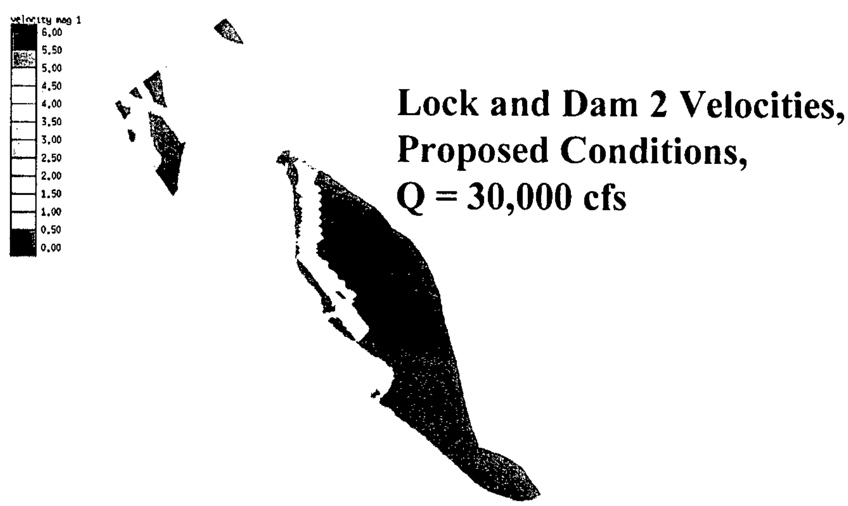
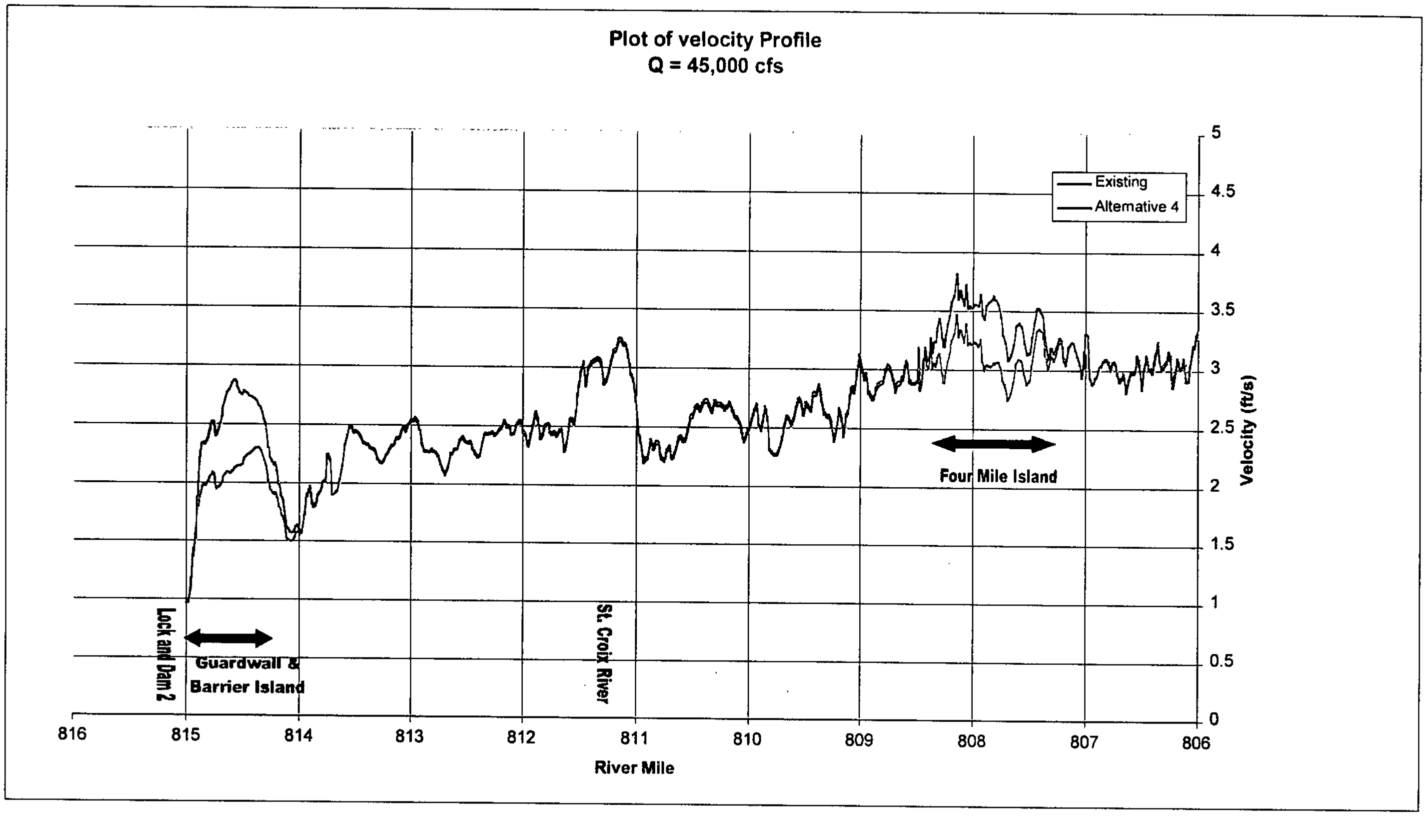


Figure C-4. Pool 3 Velocity Profile.



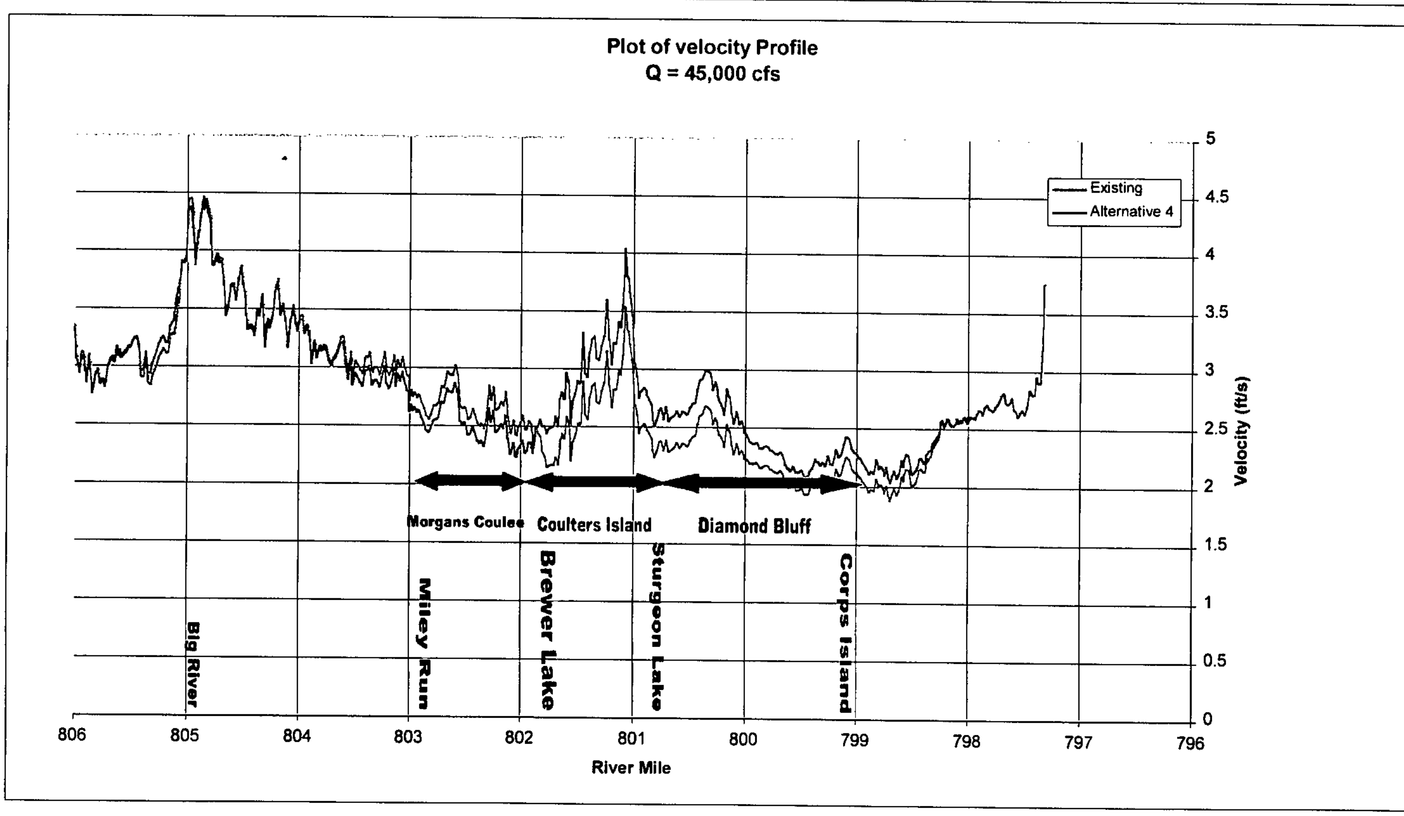
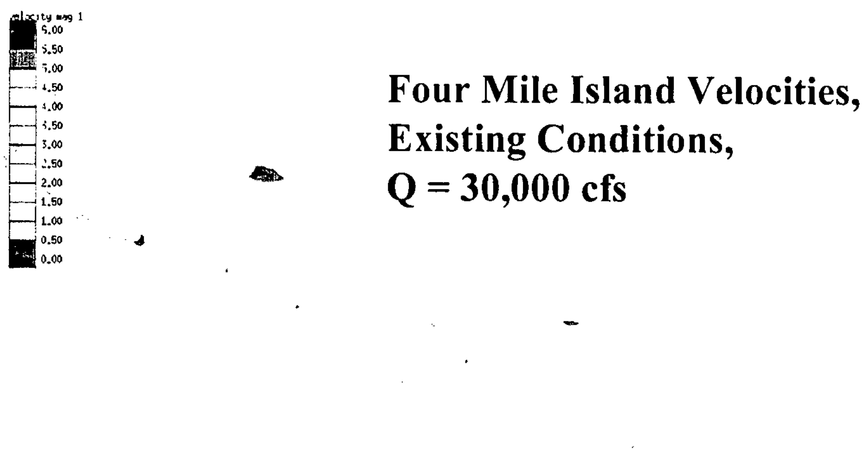


Figure C-5. Four Mile Island Velocities.



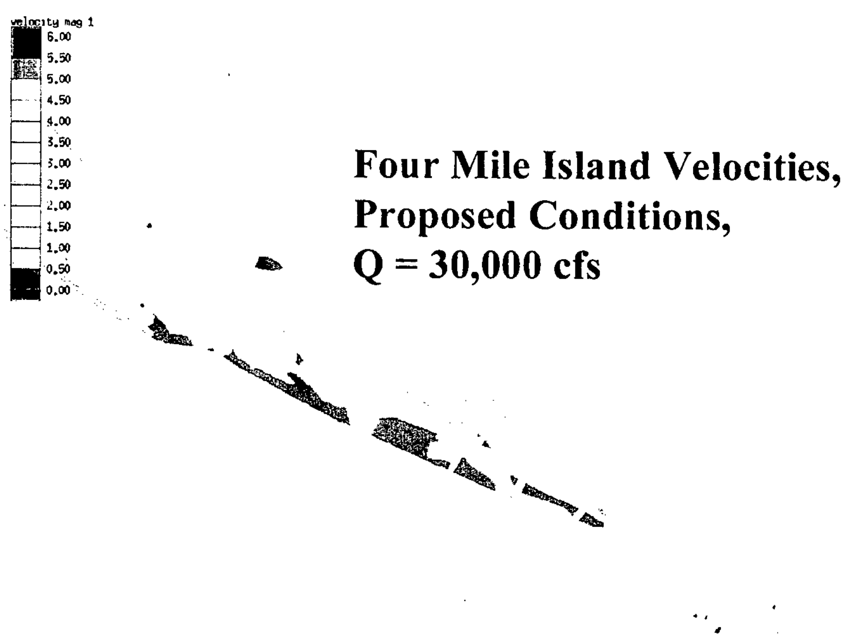
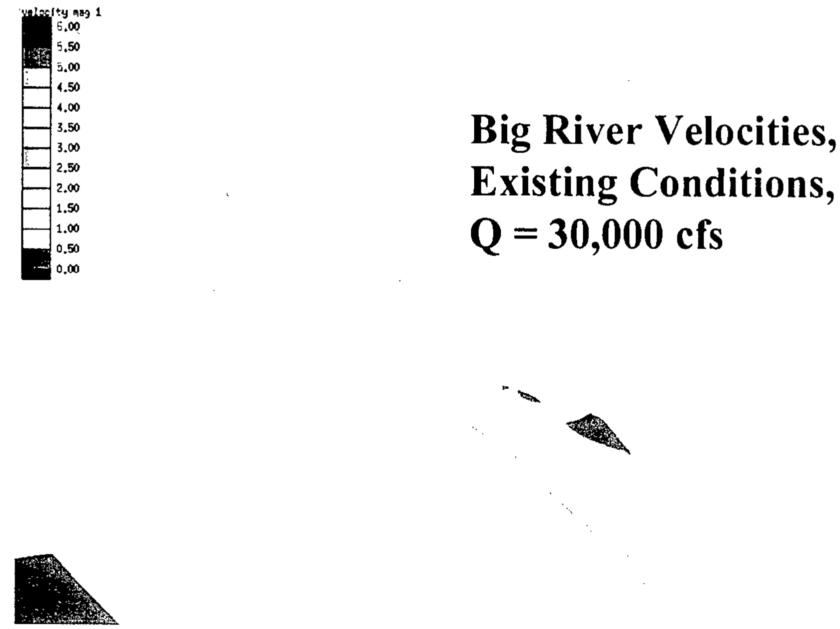


Figure C-6. Big River Velocities.



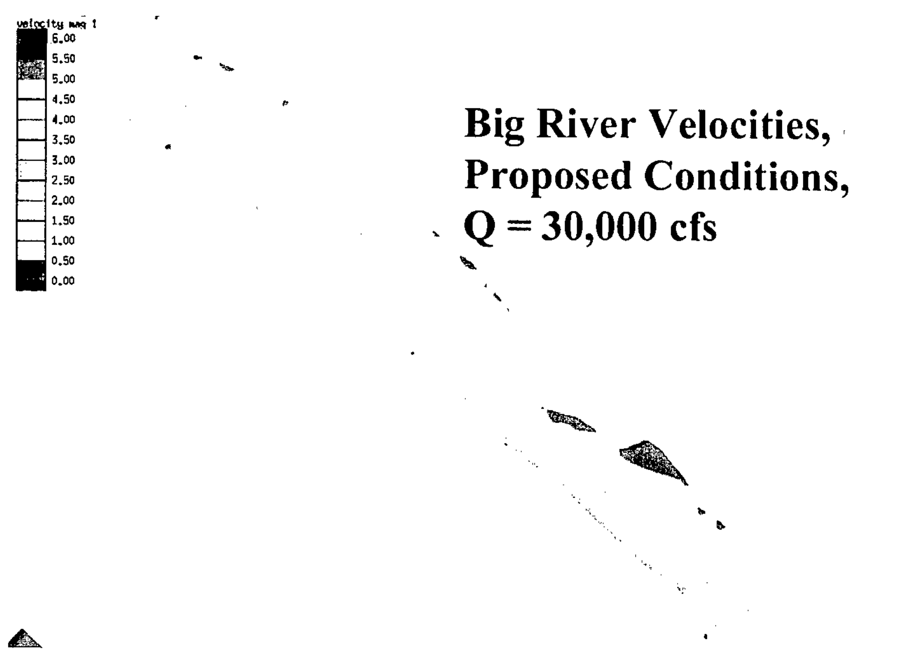
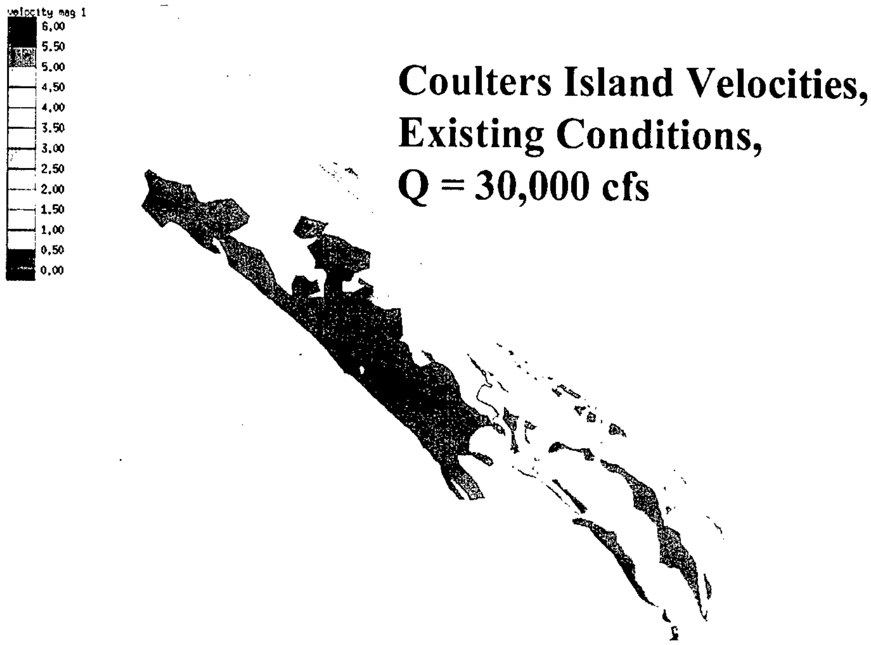


Figure C-7. Coulters Island Velocities.



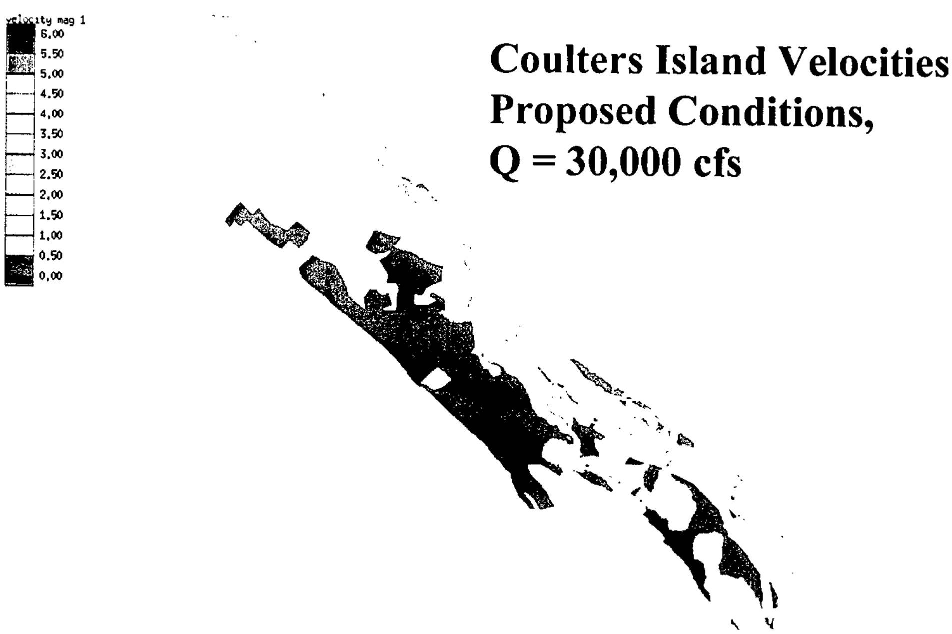
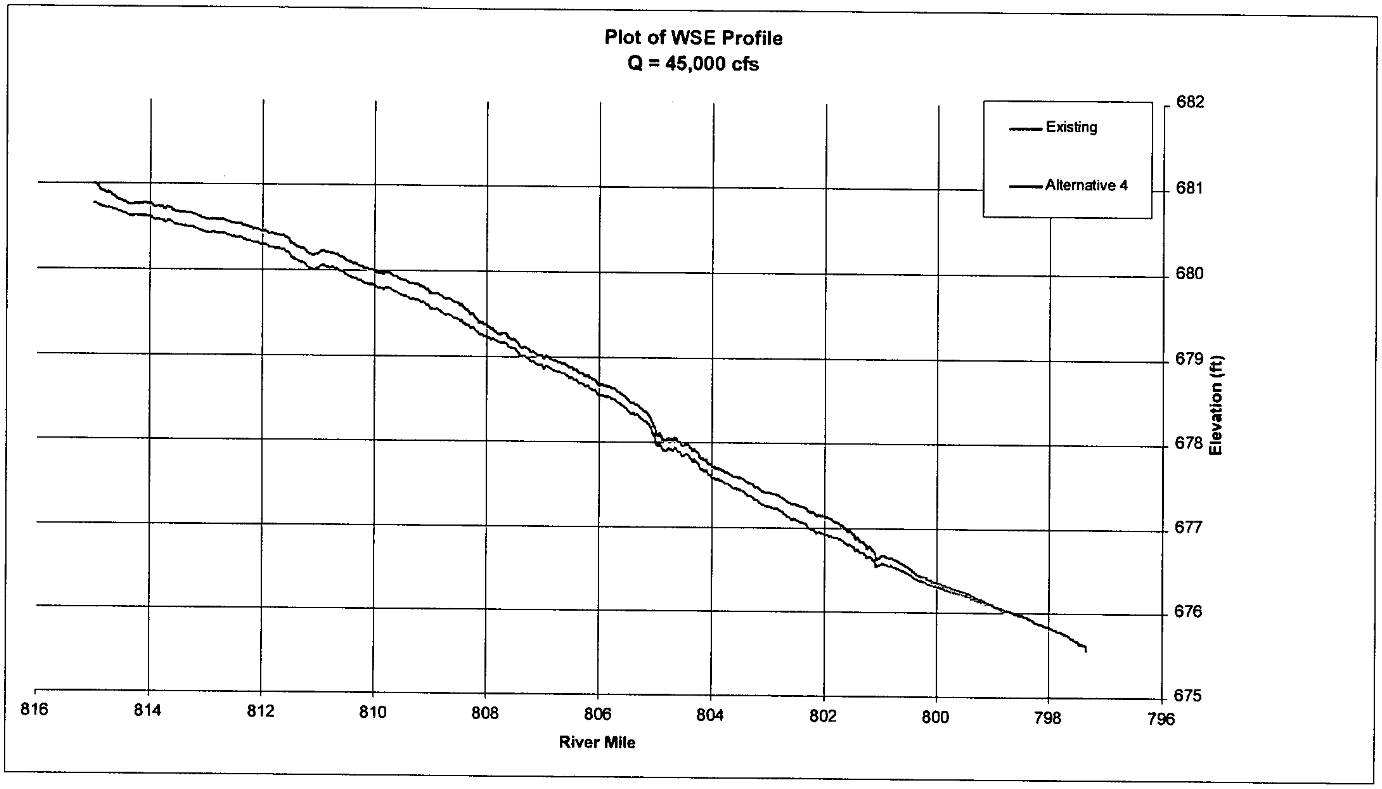
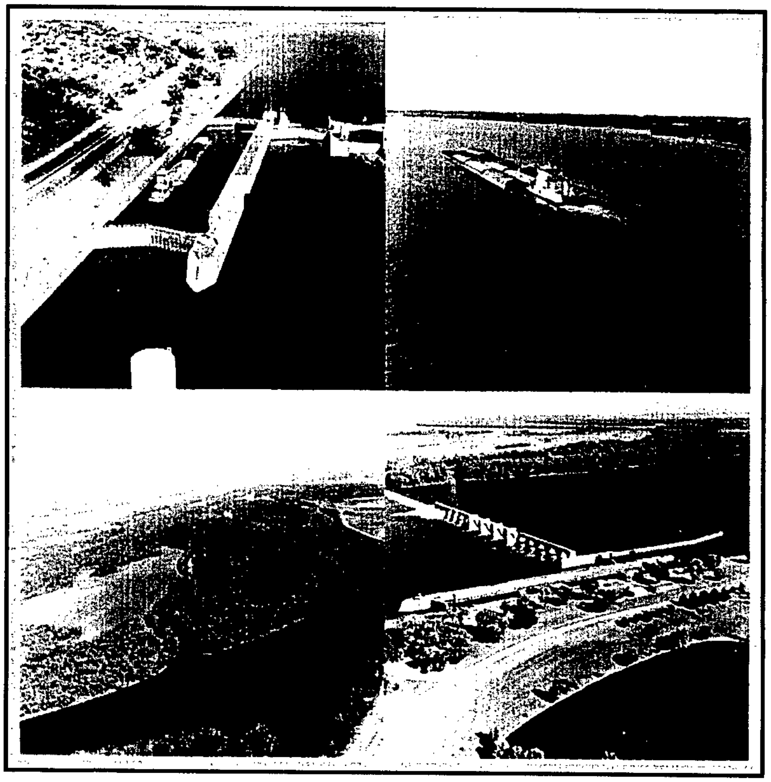


Figure C-8. Water Surface Elevation Change for a Total River Discharge of 45,000 cfs.



2-D HYDRODYNAMIC MODELING OF POOL 3 UPPER MISSISSIPPI RIVER

CONTRACT No. DACW37-00-D-0001
Task Order No. 0001



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1 INTRODUCTION

1.1 General

Pool 3 (River Miles 796.9 to 815.2) of the Upper Mississippi River requires annual dredging to maintain a navigable channel. At several locations in this reach, navigation conditions are poor, due to outdraft problems or navigation channel configuration. This reach provides excellent fish and wildlife habitat, though opportunities exist to improve habitat quality in several areas, and this reach provides numerous recreational opportunities.

1.2 Study Purpose

The purpose of this study is to identify river modifications that would optimize navigation channel maintenance, improve fish and wildlife habitat, and enhance recreational opportunities.

1.3 Authorization

WEST Consultants, Inc. (WEST) was contracted to conduct this study under Contract No. DACW37-00-D-0001, Delivery Order No. 0001, with the St. Paul District, Corps of Engineers ("District"). WEST was assisted by their subcontractor, Polaris Group Inc. (Polaris). The Contracting Officer's Representative (COR) was Mr. Jon Hendrickson. Mr. Aaron Buesing assisted him as project engineer.

1.4 Scope of Work

The work to be performed consisted of developing a two-dimensional hydrodynamic model of the existing conditions in Pool 3, from Lock & Dam 2 (L&D2) to Lock & Dam 3 (L&D3). The District, in consultation with natural resource agencies, developed three preliminary design alternatives to be simulated using the two-dimensional hydrodynamic model. Each alternative could contain several river modifications, assuming that river modifications made in one sub reach do not affect conditions in other areas of the Pool. This allowed one model simulation to evaluate up to three river modifications considered for the Pool. District staff then examined output from the three preliminary alternatives, and one final alternative was developed and simulated with the model. The work performed had the following elements:

- Develop a two-dimensional hydrodynamic model of Pool 3
- Calibrate and verify the model to measured data using reasonable ranges of parameters,
- Compare model results with discharge rating curves provided by the District
- Simulate three river discharges (10,000, 30,000 and 45,000 cfs)
- Simulate three preliminary and one final alternatives

- Coordinate with District staff
- Provide District with model results and electronic files
- Provide District with various color output plots

2 MODEL DEVELOPMENT AND CALIBRATION

2.1 Description of Modeling System

The hydraulic analysis used the hydrodynamic program, RMA-2, Version 4.3 (Thomas and McAnally, 1991; WES, 1996). RMA-2 is a two-dimensional, depth-averaged, finite-element, hydrodynamic numerical model. The model computes water surface elevations and horizontal velocity (x and y) components for subcritical, free-surface flow in two-dimensional flow fields. RMA-2 solves a finite-element solution of the Reynolds form of the Navier-Stokes equations for turbulent flows. Friction is calculated using the Manning's or Chezy equation, and eddy viscosity coefficients are used to define turbulence characteristics. Both steady and unsteady state (dynamic) problems can be analyzed. RMA-2 is unstructured and implicit, and can handle complex systems where many plan meshes are developed with high resolution in regions of large velocity gradients.

The RMA-2 model and the grid pre-processing program, GFGEN, were run within the SMS system, Version 6.0 (BYU, 1999). SMS, or Surface water Modeling System, is a graphic pre- and post-processing program. The program has tools to set up and edit the finite-element grid, apply boundary conditions, assign bottom friction and eddy viscosity coefficients, and then export the information as input files for GFGEN and RMA-2. Once RMA-2 has been run, the results can be imported into SMS where they can be displayed and plotted.

The programs were run on desktop PC workstations, operating under Microsoft Windows and DOS.

2.2 Development of Finite-Element Grid

Figure 2-1 shows a plan view of Pool 3, and includes some key landmarks. The District provided the geometry of Pool 3 in several forms:

- A detailed side-scan sonar survey of the main channel of Pool 3 and some of the entrances to side channels that connect the main river channel with North and Sturgeon Lakes to the west (right side, viewed downstream) was performed in 1992. The survey was imported into the District's GIS system and approximately seven million data points developed at nominally one meter intervals (both along and across the channel). The

survey did not include North and Sturgeon Lakes, and did not include shallower areas adjacent to the low-flow edges of water.

- Several cross-sections from 1999 for various channels from the main channel to North and Sturgeon Lakes.
- Digital ortho-photographs from 1992.
- Some unreferenced ortho-photographs from 1998 that showed some changes in geomorphology in Pool 3, particularly in the secondary channels.
- Several old bathymetric charts of North and Sturgeon Lakes.

The 1992 detailed survey, the channel cross-sections, and the 1992 digital ortho-photographs were referenced, in feet, horizontally to Minnesota South State Plane Coordinates, and vertically to NAD 1983. The 1992 digital ortho-photographs were imported into SMS, and a finite-element grid developed for the main channel with a nominal resolution of 115 ft along the channel and 75 ft across. The 1992 detailed survey points and estimates of the water surface elevations corresponding to the edges of water from the ortho-photographs were also imported into SMS, and used to interpolate node channel bed elevations. Next, the 1999 cross sections of non-detailed-surveyed channels were input by hand. Finally, a coarser grid of North and Sturgeon Lakes was developed, and bottom elevations assigned using interpolations from a set of geo-referenced elevations developed from the old charts of these two lakes. The highest elevation used in the model grid is lower than estimated water surface elevations for the "low" flow of 10,000 cfs, so that the grid would always be "wet" and the wetting and drying option of RMA-2 would not have to be used.

2.3 Grid Modification

To simulate the various design alternatives, the "calibrated" finite-element grid was modified to refine it in those areas of the Pool where design alternatives were being considered. Figure 2-2 shows the resulting finite-element grid, and Figure 2-3 shows the representation of the bottom geometry. The grid has 16,260 elements and 49,311 nodes (including mid-side nodes). Flows from L&D2 are specified along the upstream boundary of the model, flows from the St. Croix River are specified at several nodes near river mile (RM) 811.3, and the fixed heads in the L&D3 headwater are specified along the downstream boundary of the model.

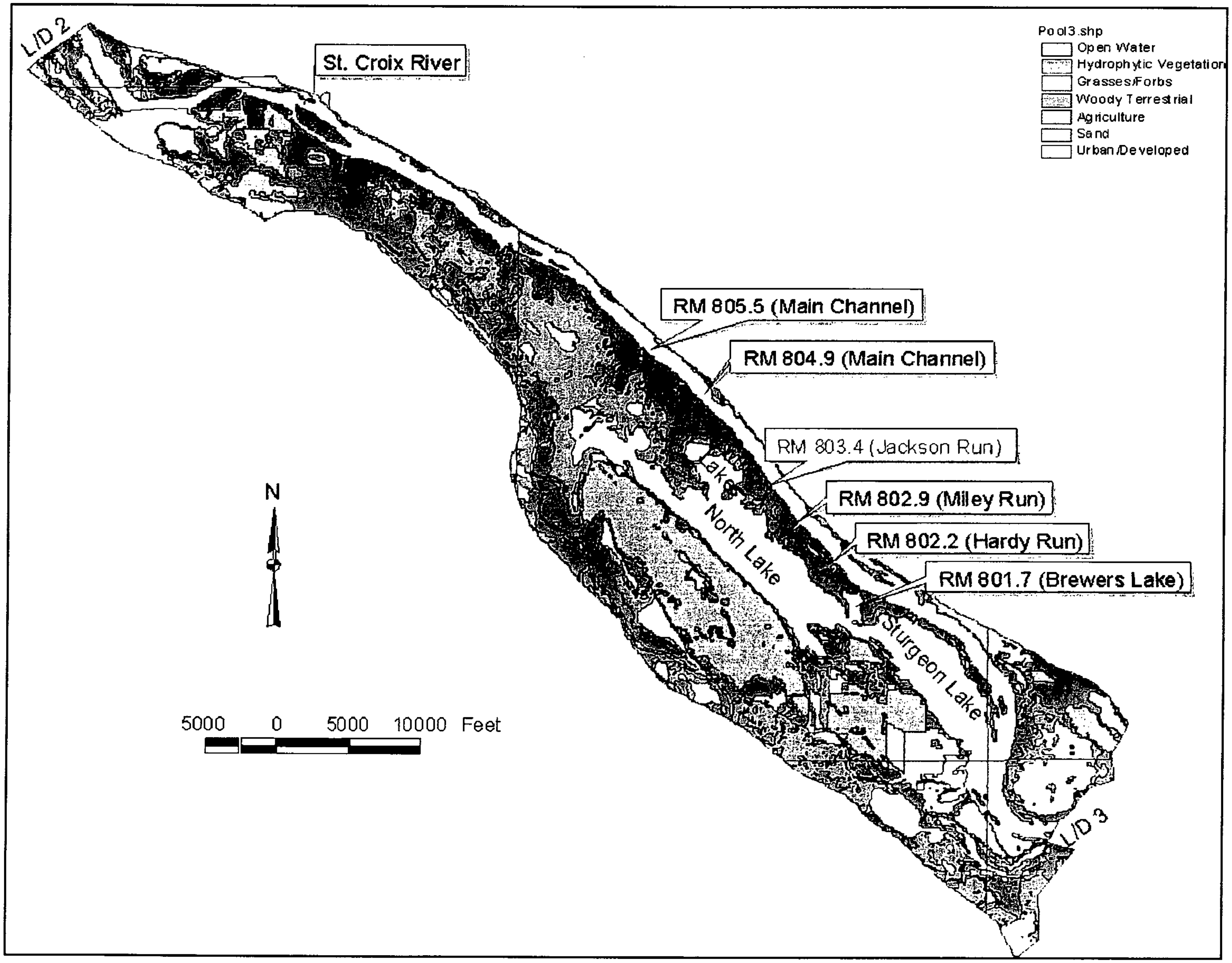

Figure 2-1: Plan View of Pool 3 (based on UMESC, 1989).

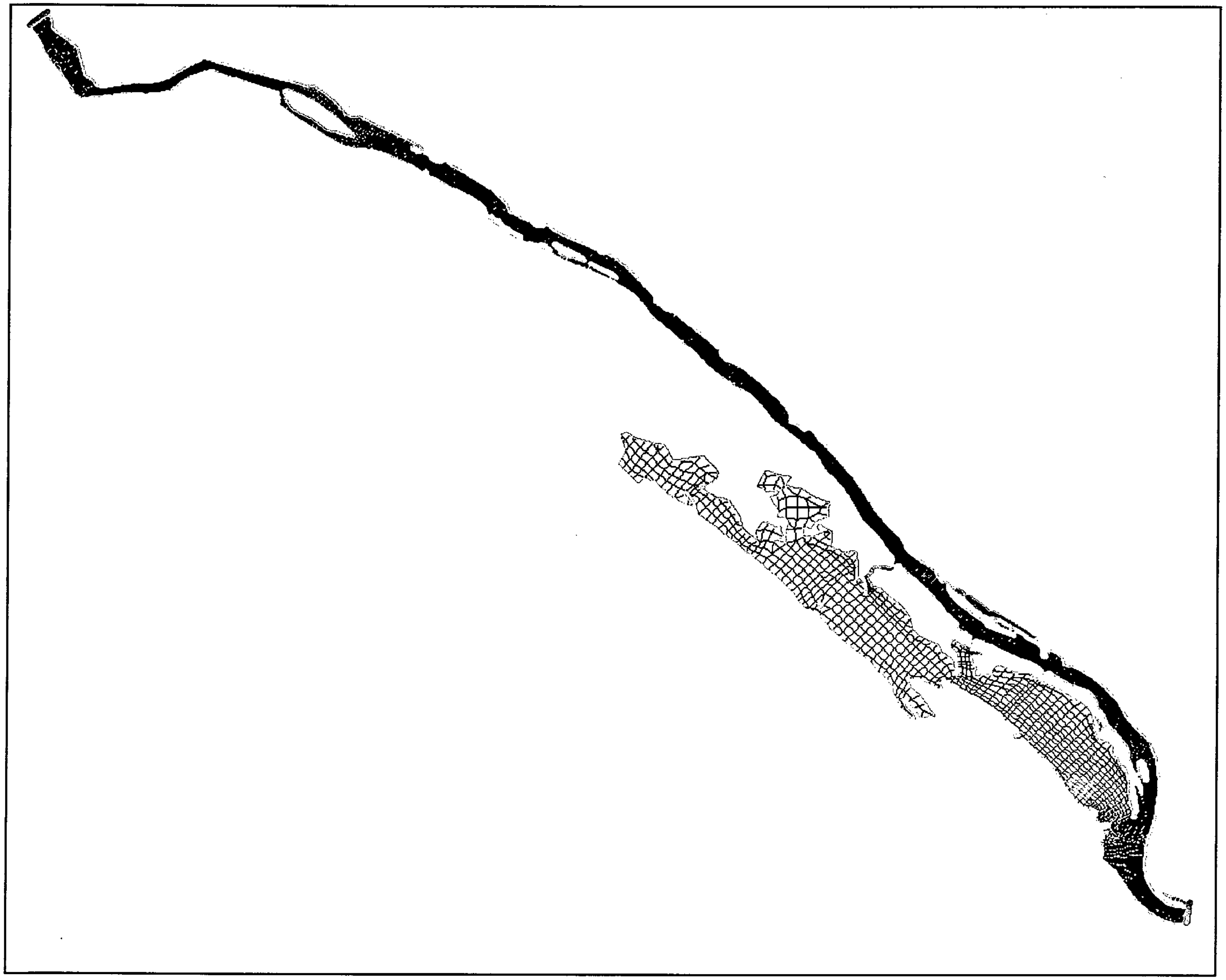

Figure 2-2: Finite Element Geometry of Pool 3

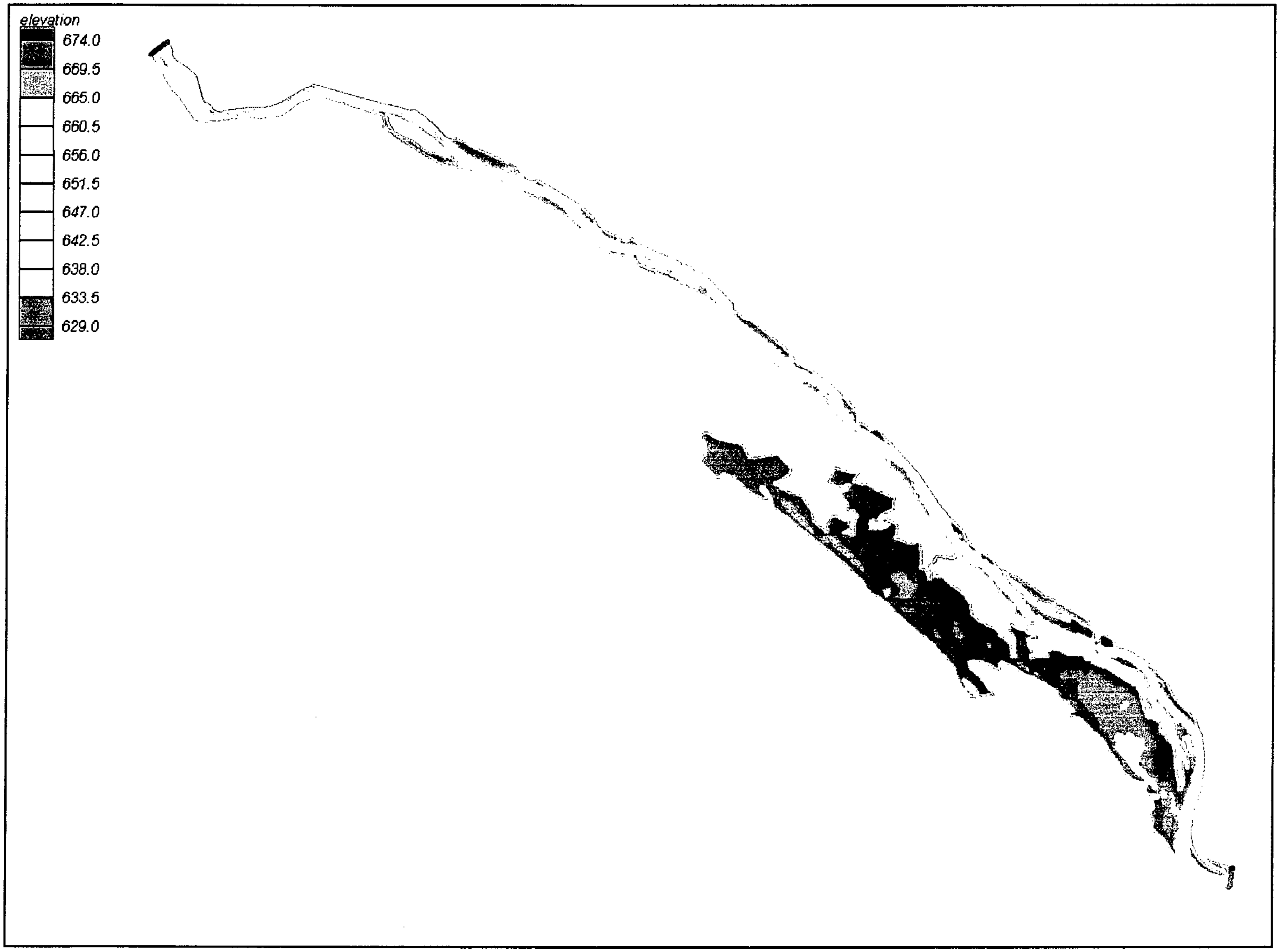

Figure 2-3: Pool 3 Bathymetry

2.4 Model Calibration and Validation

Calibration and validation data consisted of:

- Flows at L&D2, from the St. Croix River (the major tributary to Pool 3, at RM 811.3), and at L&D3 (Table 2-1)
- A "rule curve" of water surface elevations at L&D3 for flows at L&D3 (Table 2-1)
- A "rule curve" for estimated water surface elevations at Prescott and L&D2 for flows at L&D3
- Observations of water surface elevations at Prescott and L&D2 for observed flows at L&D3
- Discharge and velocity rating curves (cross sectional flow versus flow at L&D3) for various locations along the main channel and in several secondary channels, developed from observations in 1991, 1994 and 1998/9.

Table 2-1: Simulated Flows in the Pool 3 Model

L&D2 flow (cfs)	St. Croix River Flow (cfs)	L&D3 flow (cfs)	Water Surface Elevation at L&D3 (feet)
7,980	2,020	10,000	674.8
23,230	6,770	30,000	674.0
35,930	9,070	45,000	675.5

The model was calibrated to a "medium" flow of 30,000 cfs at L&D3. 23,230 cfs was specified at the upstream boundary at L&D2, and an additional 6,770 cfs from the St. Croix River. Mannings *n* bottom roughness coefficients along the main channel and in the lakes were adjusted until a longitudinal profile of water surface elevations was in good agreement visually with the water surface elevation rule curve and various observations along the Pool. Figure 2-4 shows the resulting calibration using a Mannings *n* value of 0.027, and model sensitivity to n=0.026 and 0.03. Mannings *n* of 0.03 was used in North and Sturgeon Lakes. A uniform eddy viscosity value of 50 lb-sec/ft^2 was used throughout the model.

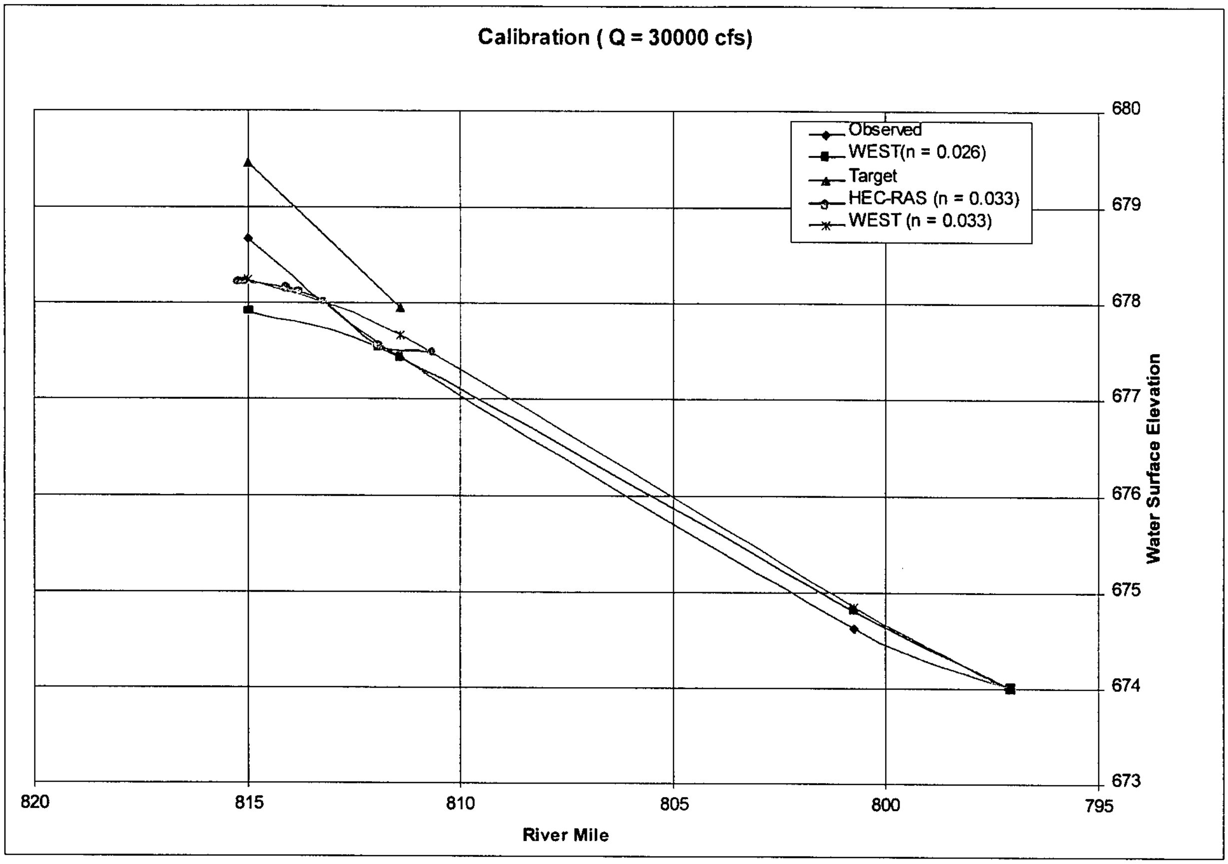

Figure 2-4: Calibration Results for Pool 3

Flows in the main channel and in some secondary channels were compared to the discharge and velocity rating curves provided by the District. After reviewing several initial simulations, it became clear that some of the discharge rating curves showed variations from one measurement period to another for the <u>same</u> discharge at L&D3. If flows had changed, they seemed to have increased with time, indicating that more water was getting through these entrances in the late 1990s compared to 1991. As we explored the reasons for this, we obtained several 1998 orthophotographs from the District and compared them to the 1992 photographs. It appeared that some of the secondary channels in 1998 were wider than they had been in 1992 (we had no information to compare depths). Consequently, the geometries of the side channels was revisited and adjusted until the flows computed in them agreed with the latest flow measurements. Figure 2-5 summaries the longitudinal distribution of flows in the main channel and various side channels for a flow of 30,000 cfs at L&D3.

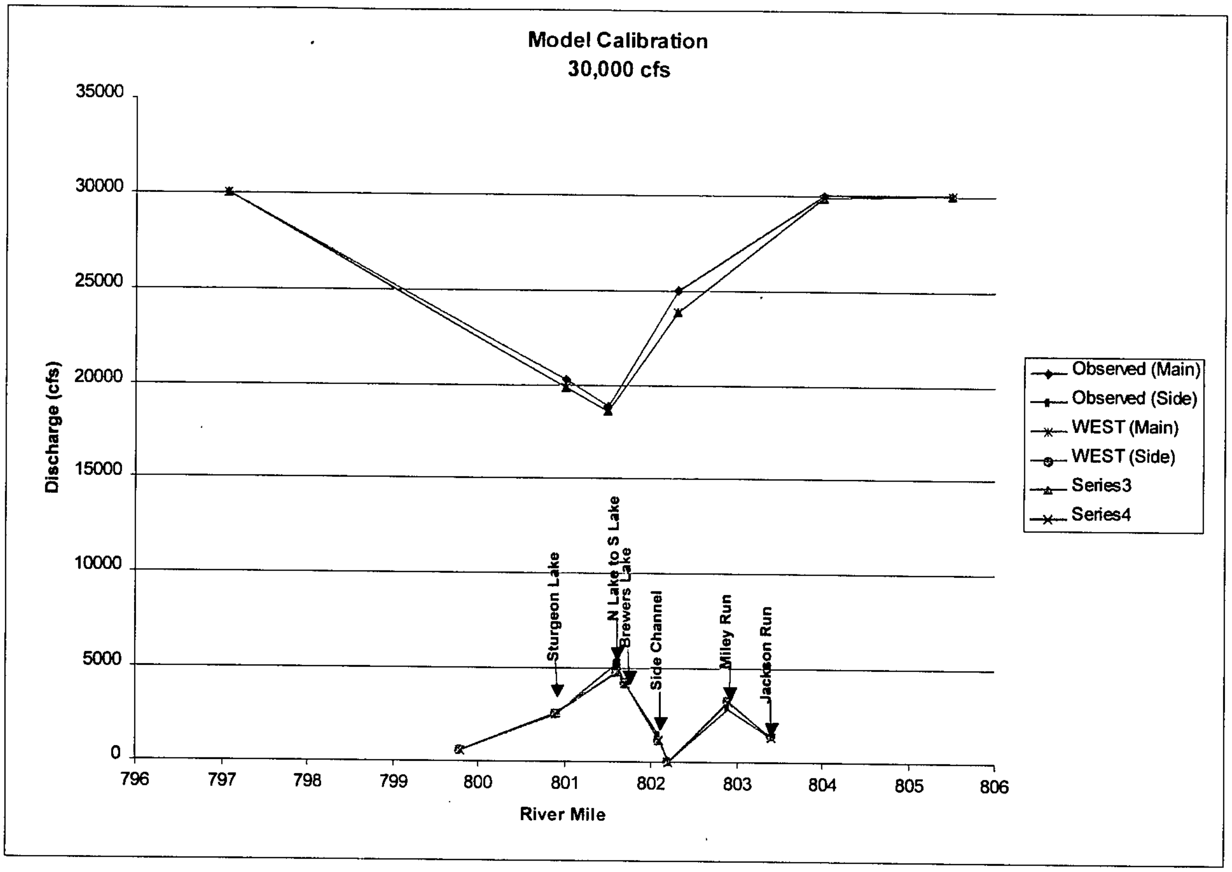

Figure 2-5: Longitudinal Flow Distribution along Main and Side Channels for Pool 3

To validate the model, the Pool 3 model was also run with L&D3 discharges of 10,000 cfs and 45,000 cfs, representing for the purposes of this study "low" and "high" discharges. Figures 2-6 through 2-19 show the comparison of the model results with the observations along the main channel and in various side channels for the three flows simulated. Figures 2-20 through 2-25 show how the model water surface elevations just downstream of L&D2 and at the Prescott gage compare with the range of observations for the same flows at L&D3. The results show good visual agreement between model simulations and observations.

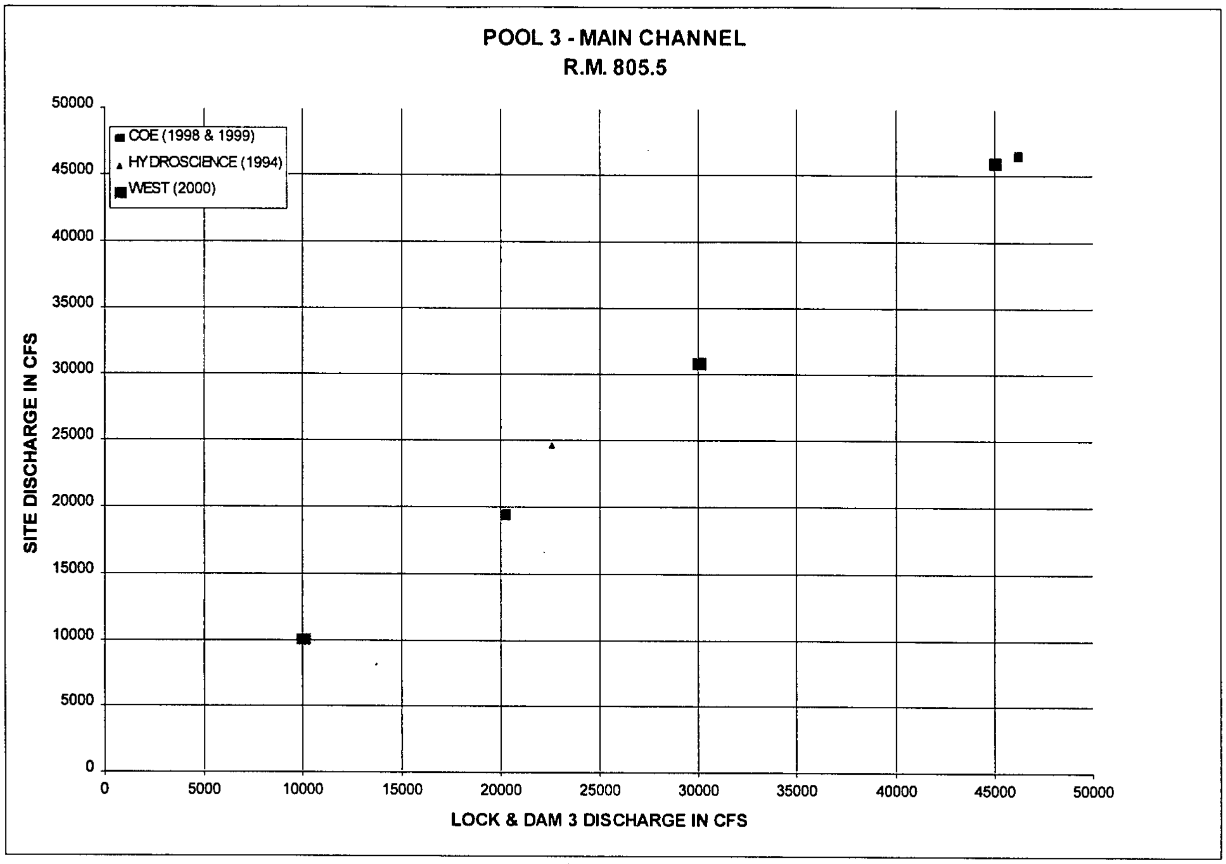

Figure 2-6: Plot of Model Discharges vs. Observed Data at RM 805.5

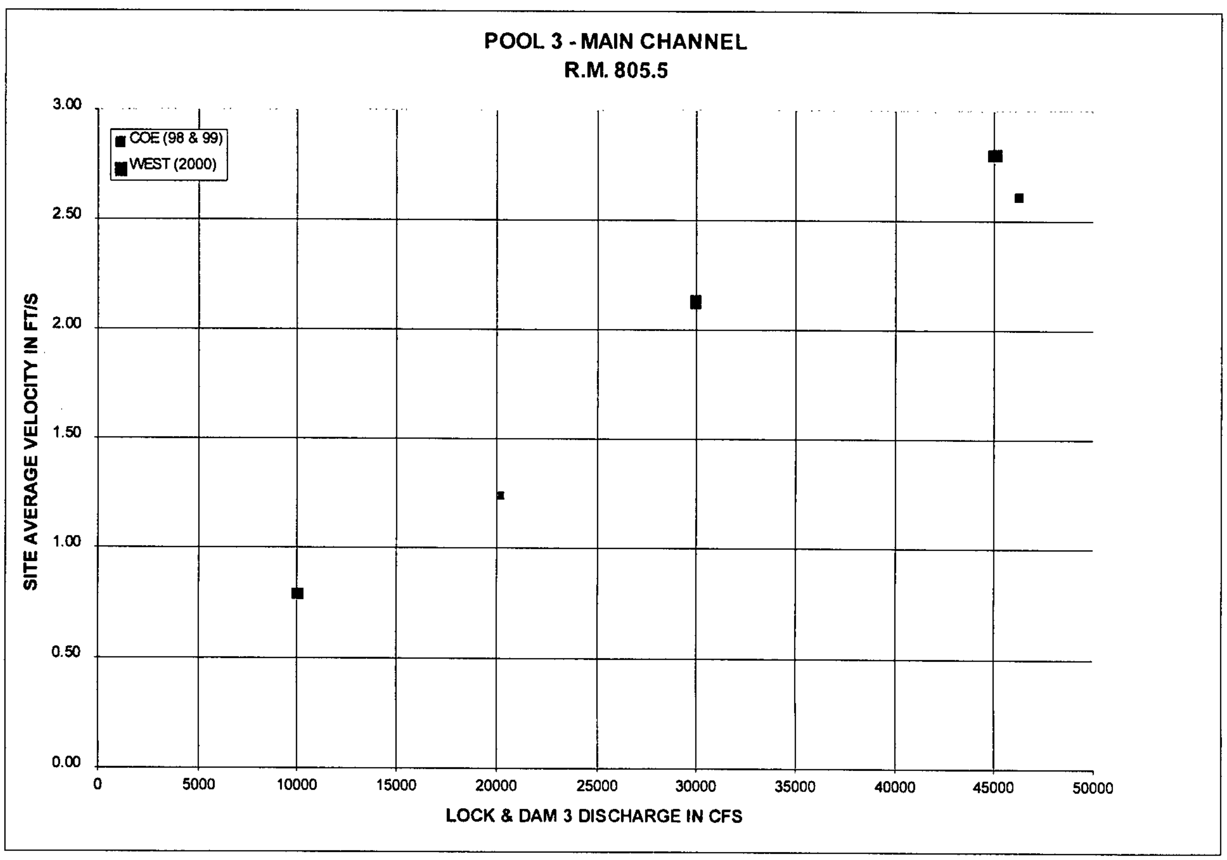

Figure 2-7: Plot of Model Velocities vs. Observed Data at RM 805.5

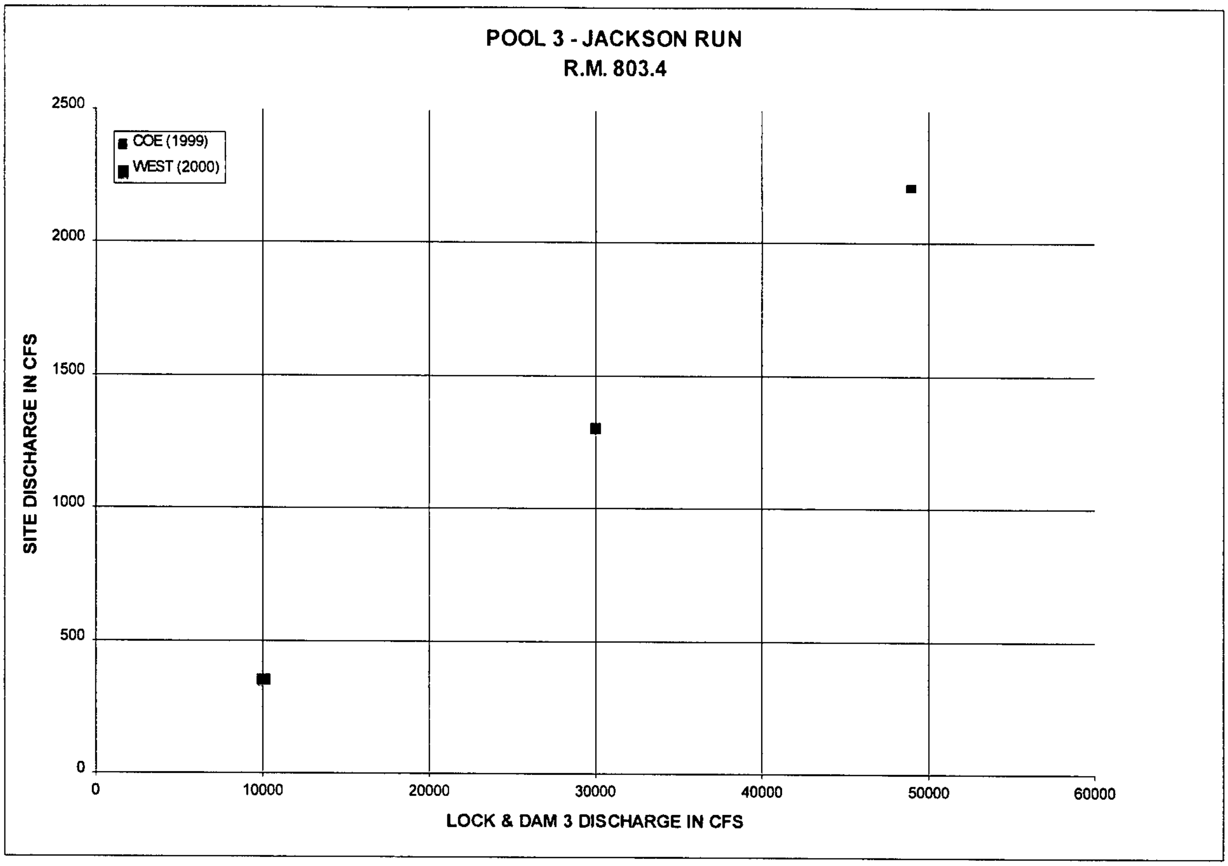

Figure 2-8: Plot of Model Discharges vs. Observed Data at Jackson Run

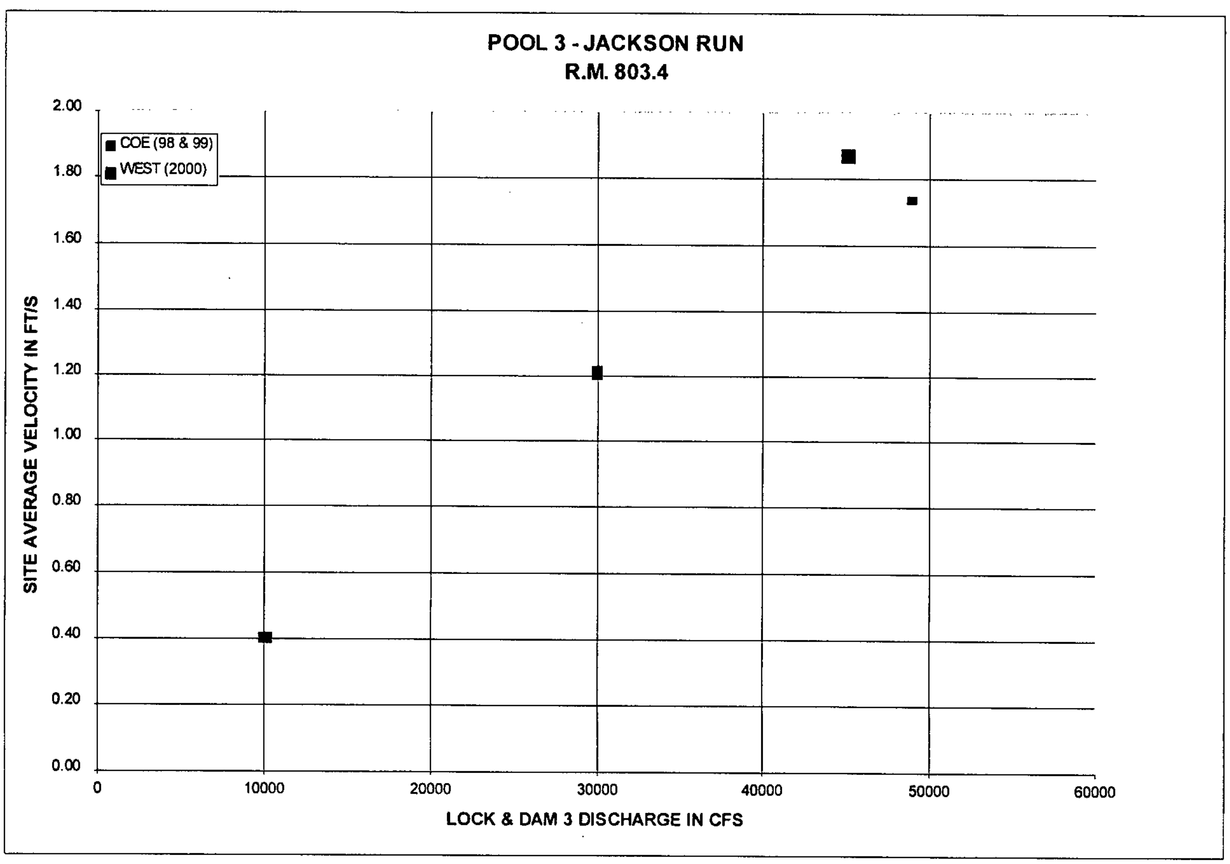

Figure 2-9: Plot of Model Velocities vs. Observed Data at Jackson Run

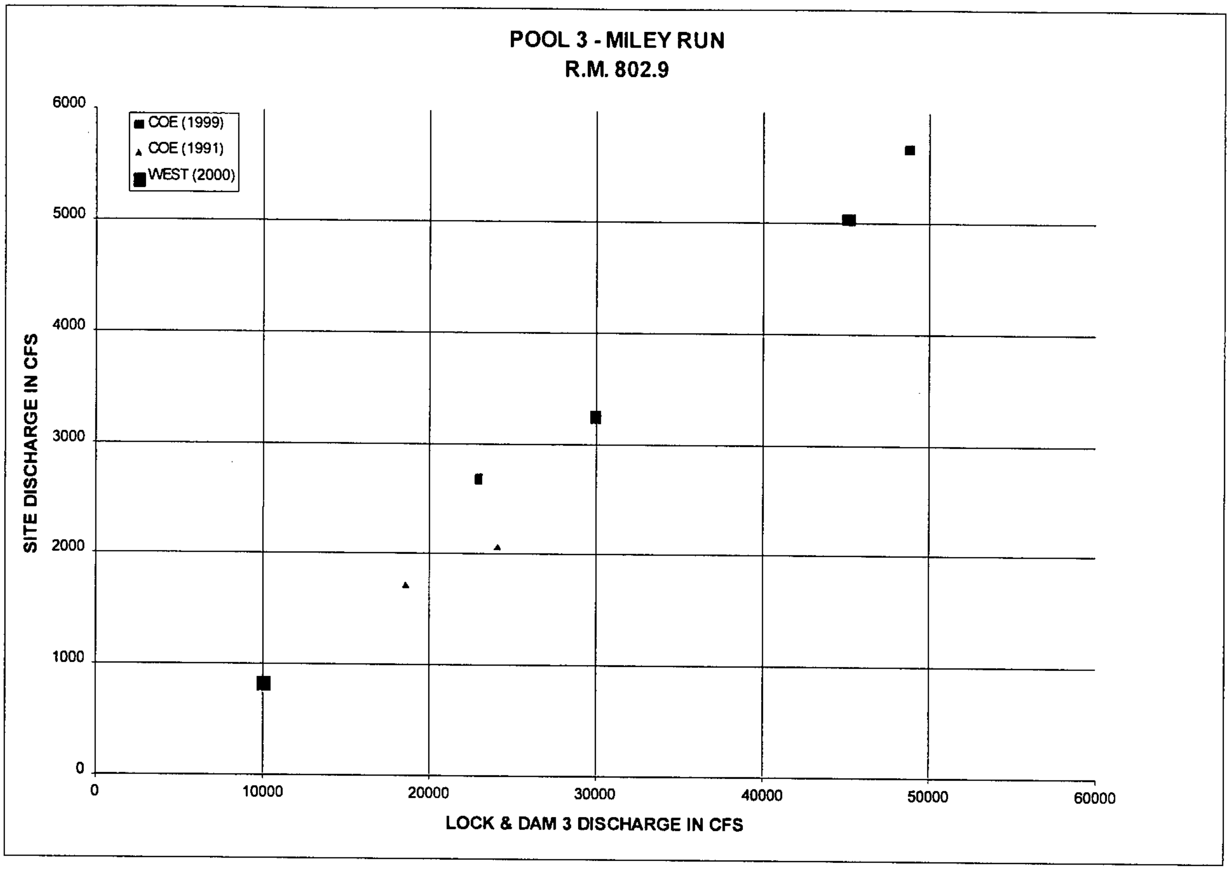

Figure 2-10: Plot of Model Discharges vs. Observed Data at Miley Run

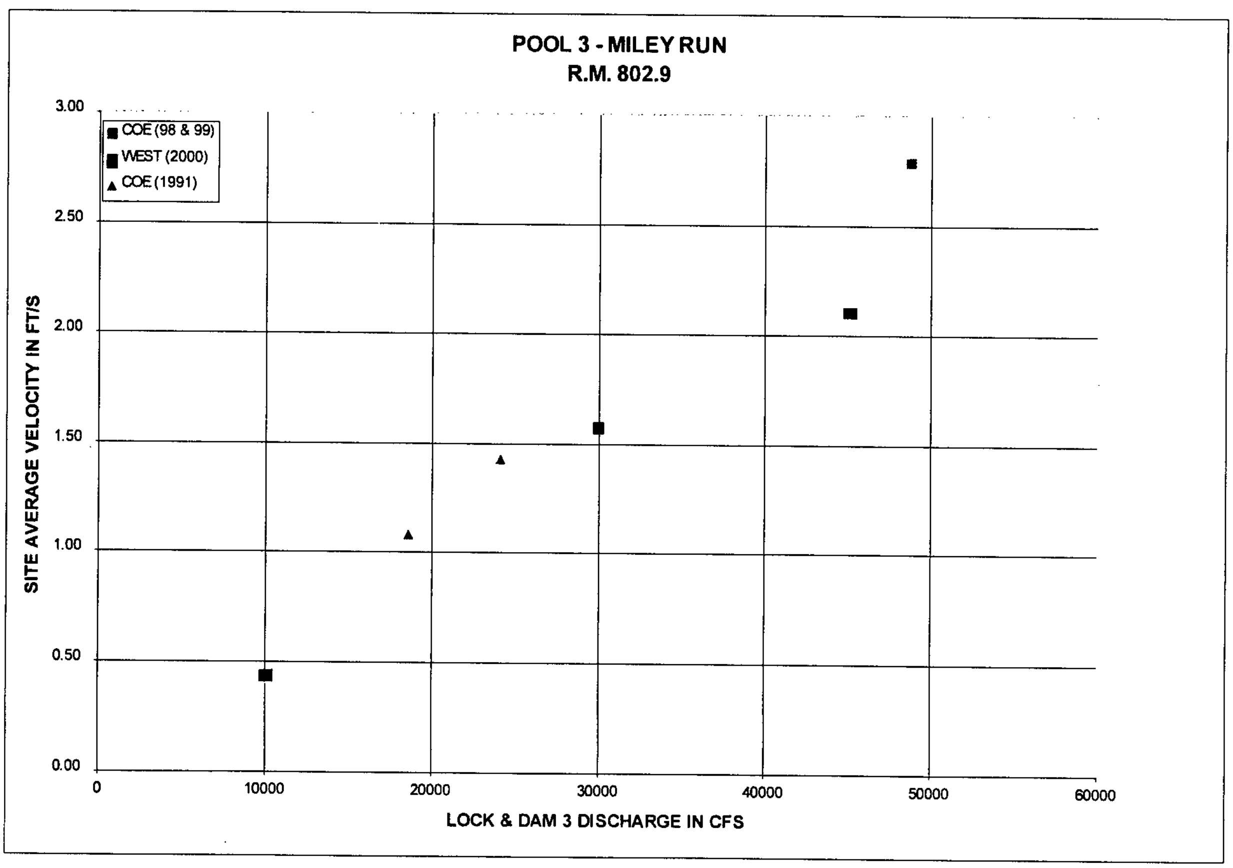

Figure 2-11: Plot of Model Velocities vs. Observed Data at Miley Run

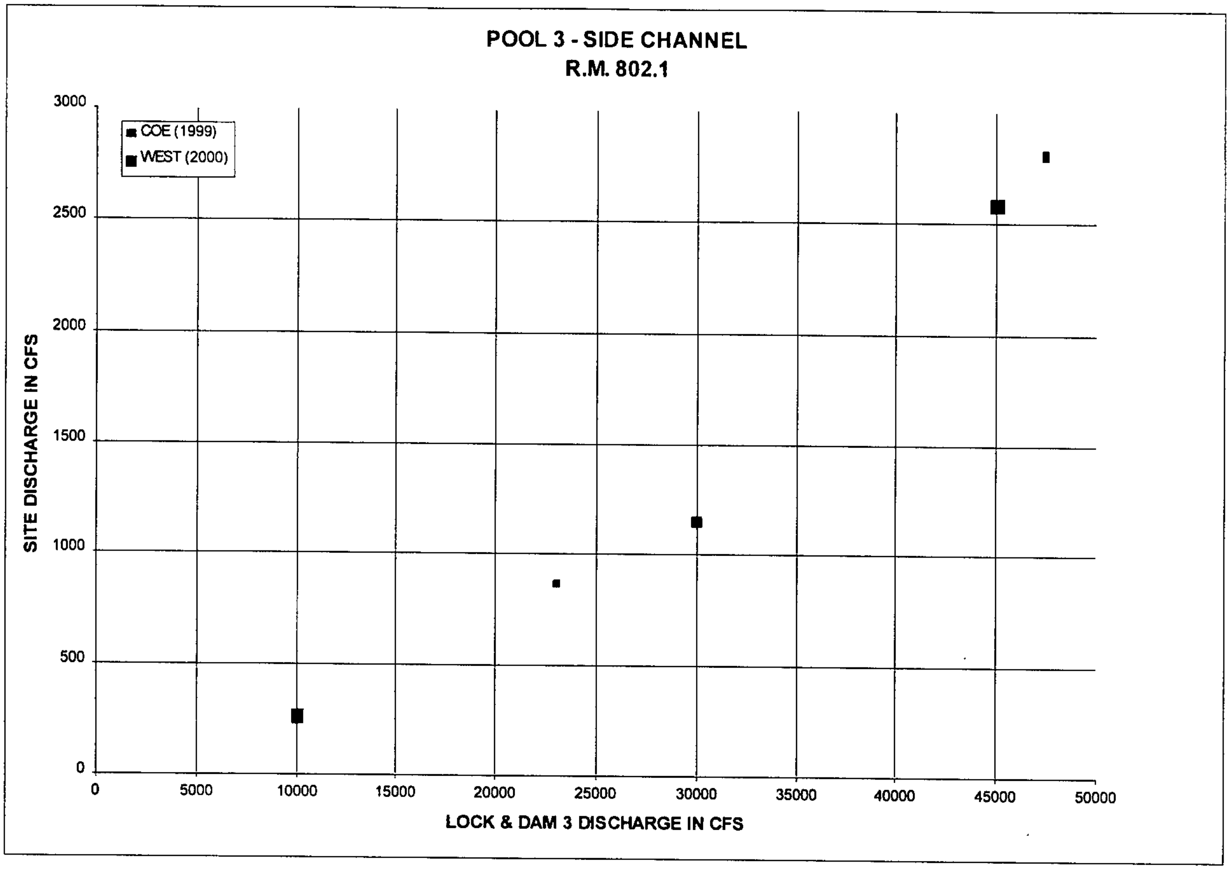

Figure 2-12: Plot of Model Discharges vs. Observed Data at RM 802.1

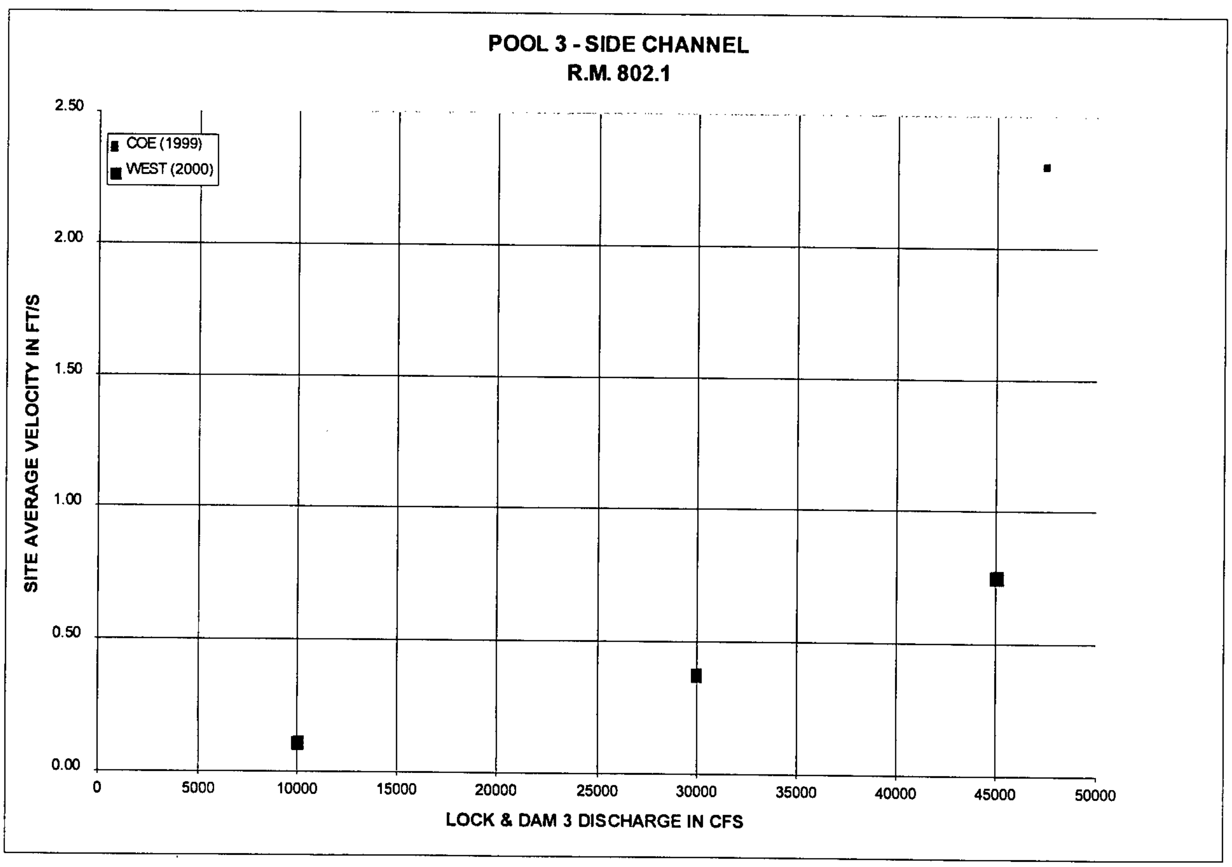

Figure 2-13: Plot of Model Velocities vs. Observed Data at RM 802.1

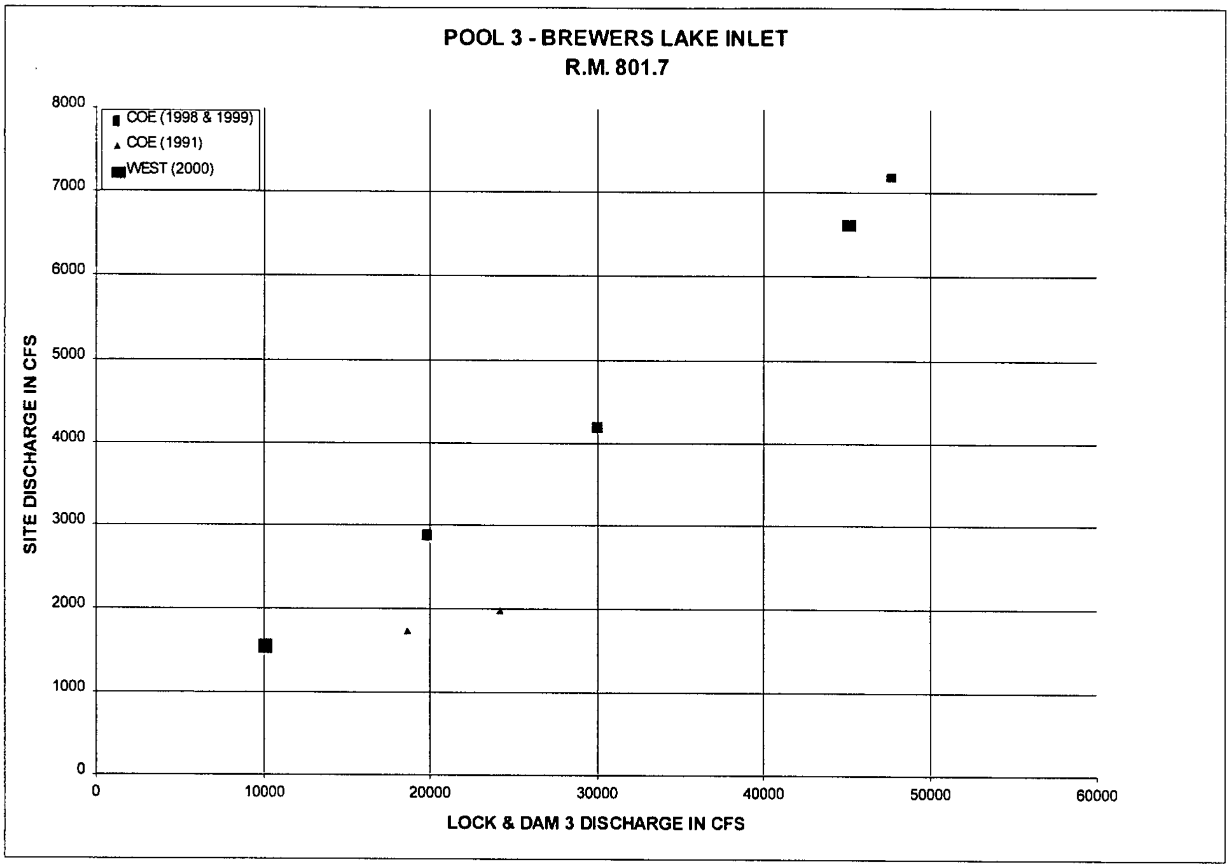

Figure 2-14: Plot of Model Discharges vs. Observed Data at Brewers Lake Inlet

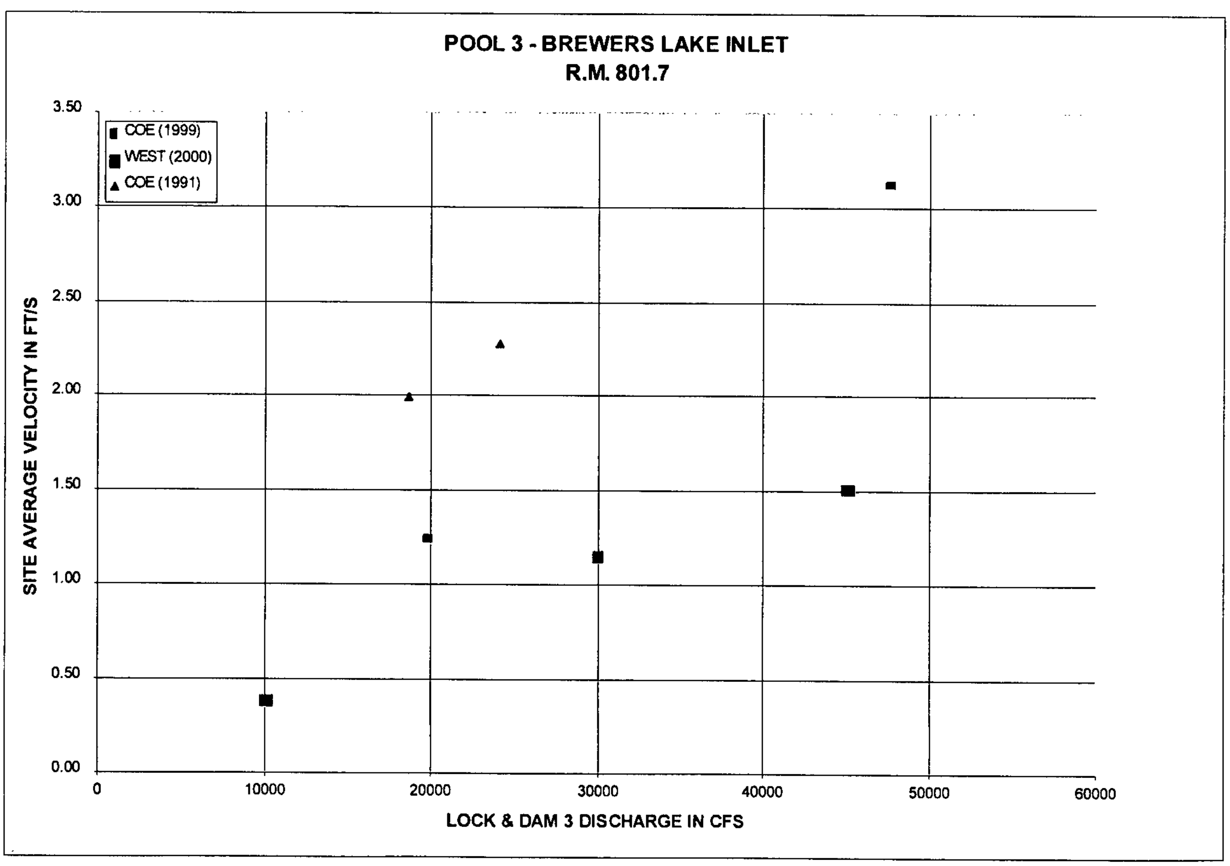

Figure 2-15: Plot of Model Velocities vs. Observed Data at Brewers Lake inlet

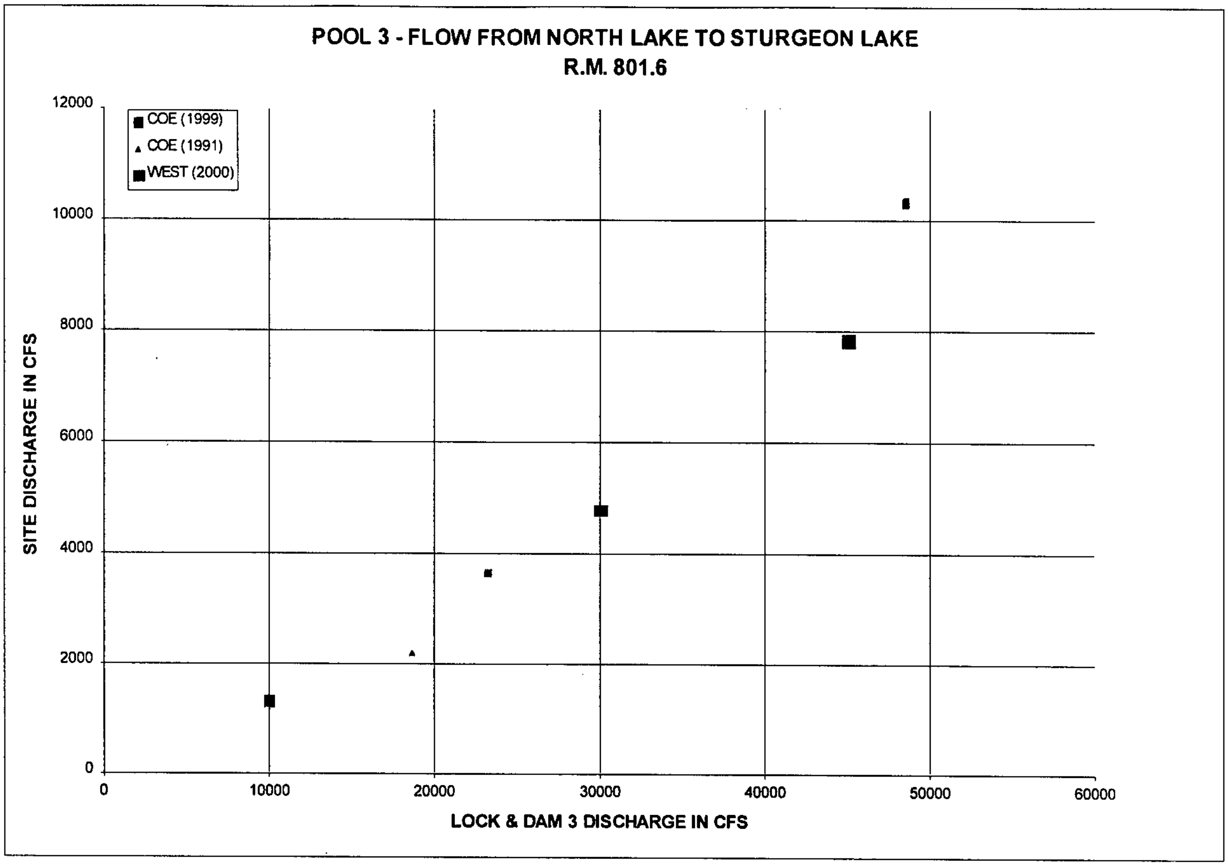

Figure 2-16: Plot of Model Discharges vs. Observed Data at RM 801.6

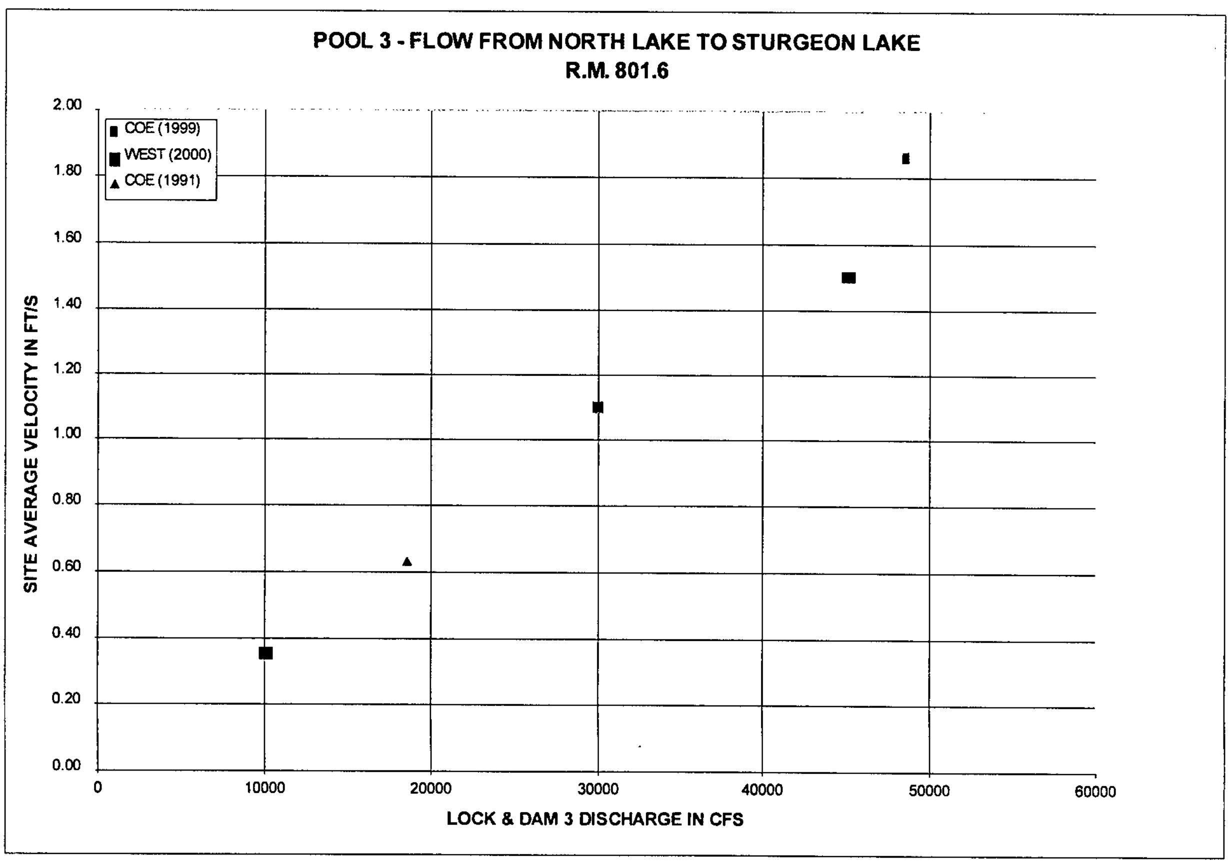

Figure 2-17: Plot of Model Velocities vs. Observed Data at RM 801.6

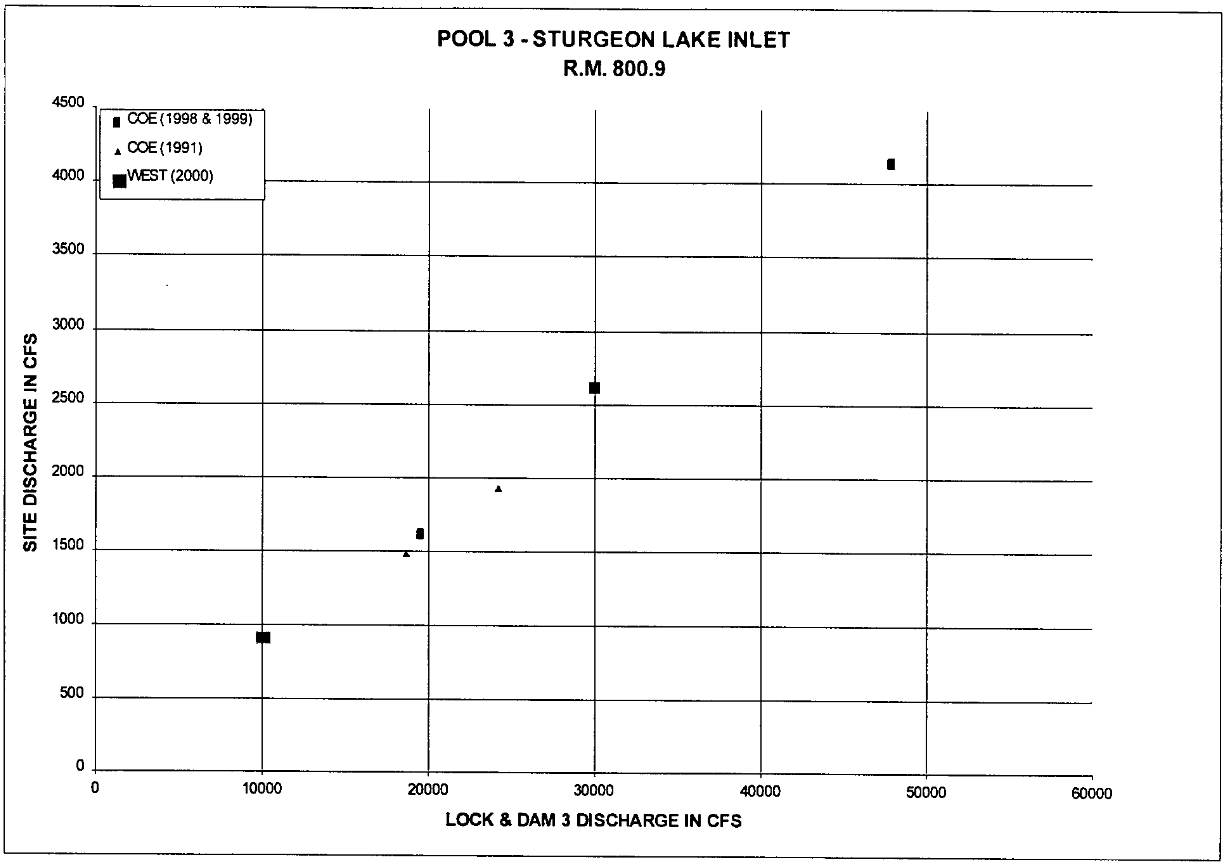

Figure 2-18: Plot of Model Discharges vs. Observed Data at Sturgeon Lake Inlet

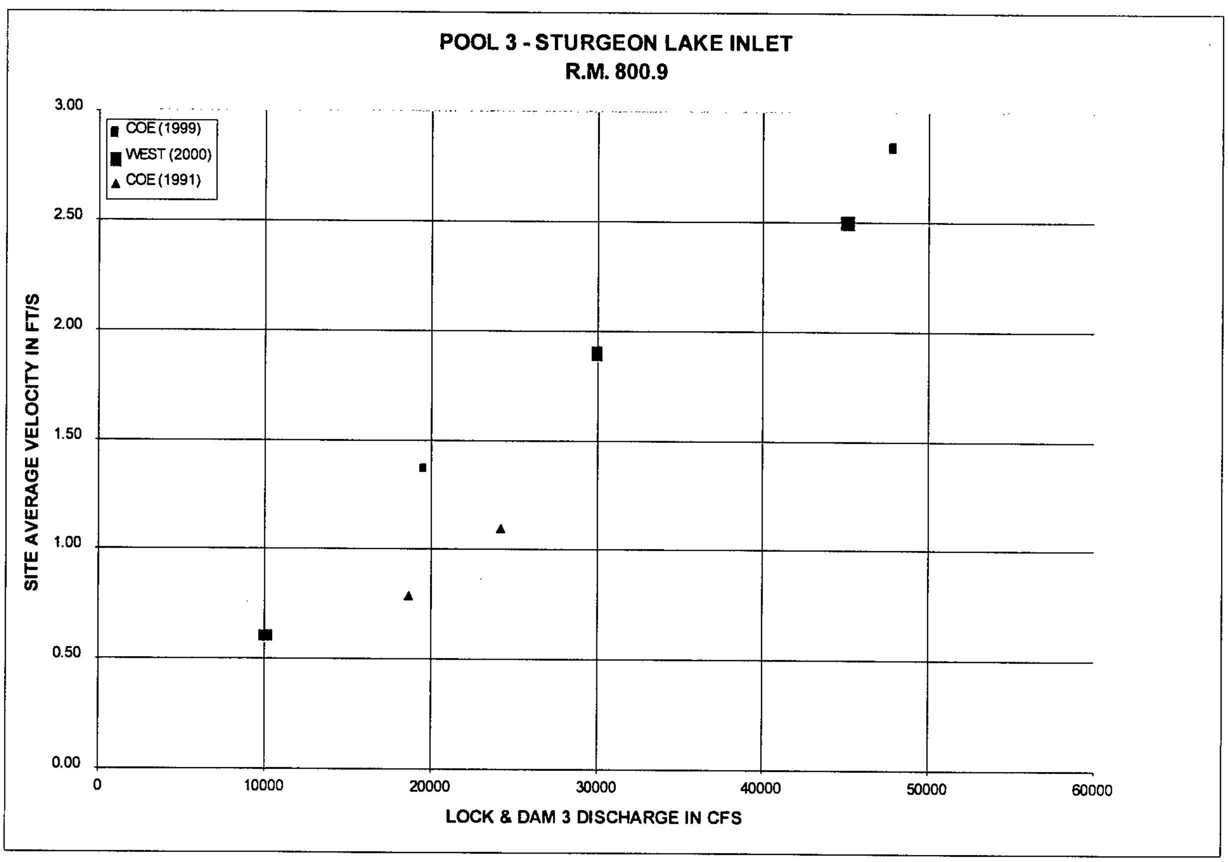

Figure 2-19: Plot of Model Velocities vs. Observed Data at Sturgeon Lake Inlet

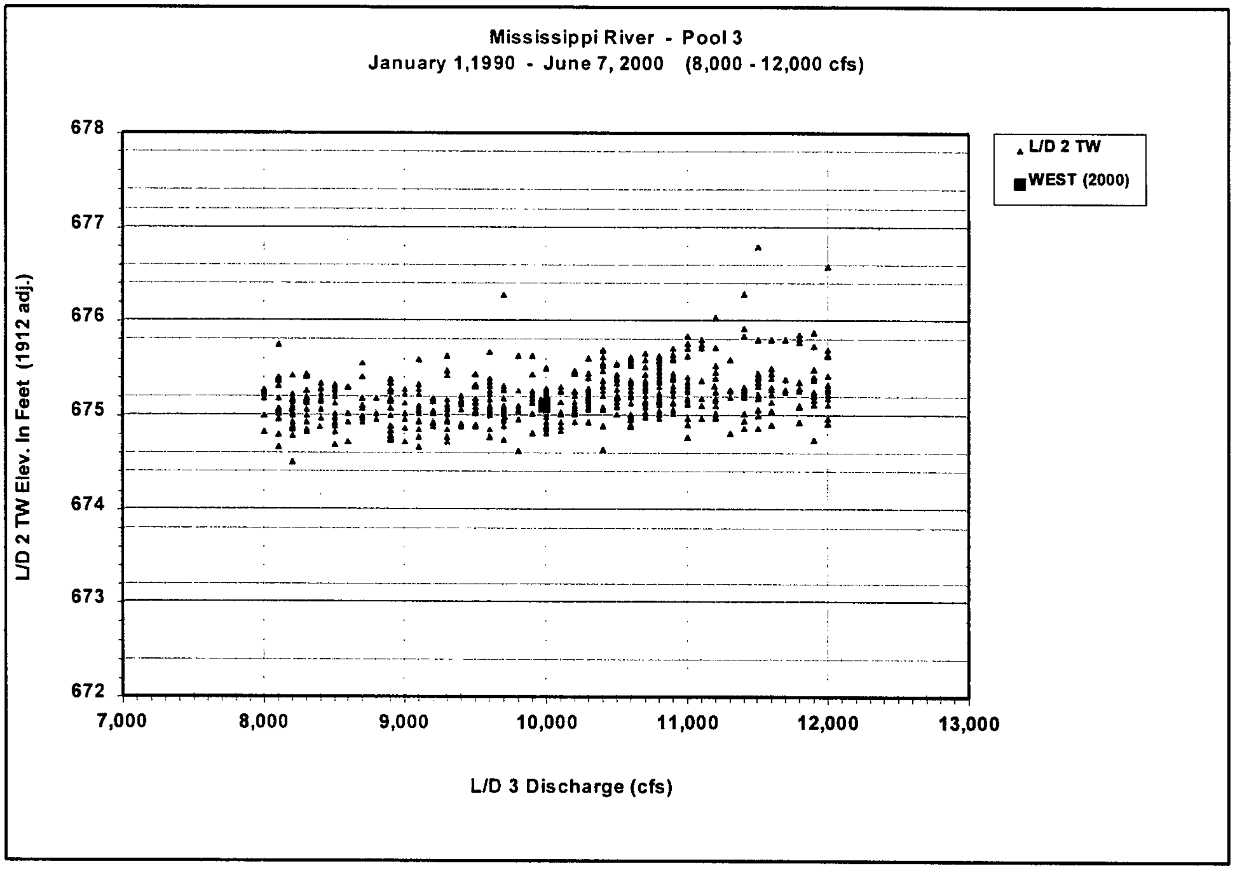

Figure 2-20: Plot of Model WSE vs. Observed Data at L/D 2 Tail Water

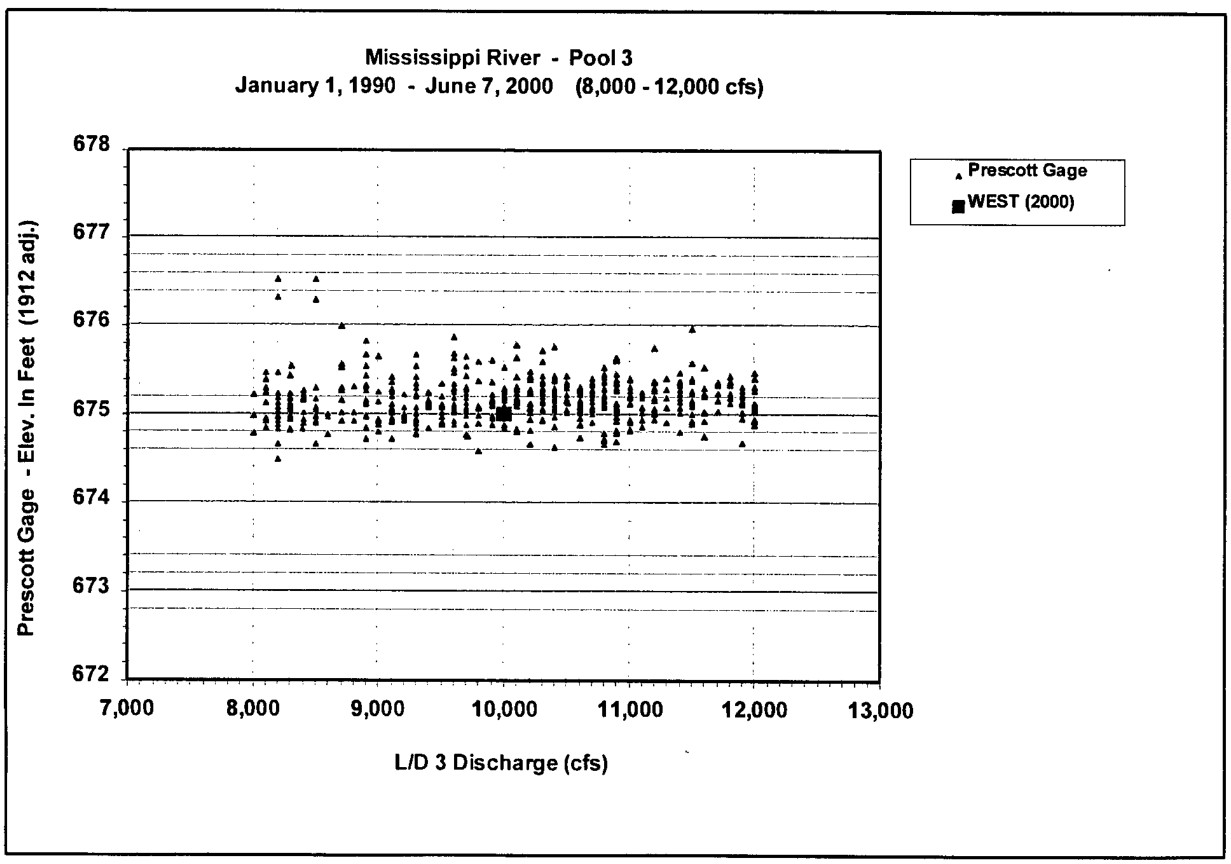

Figure 2-21: Plot of Model WSE vs. Observed Data at Prescott Gage

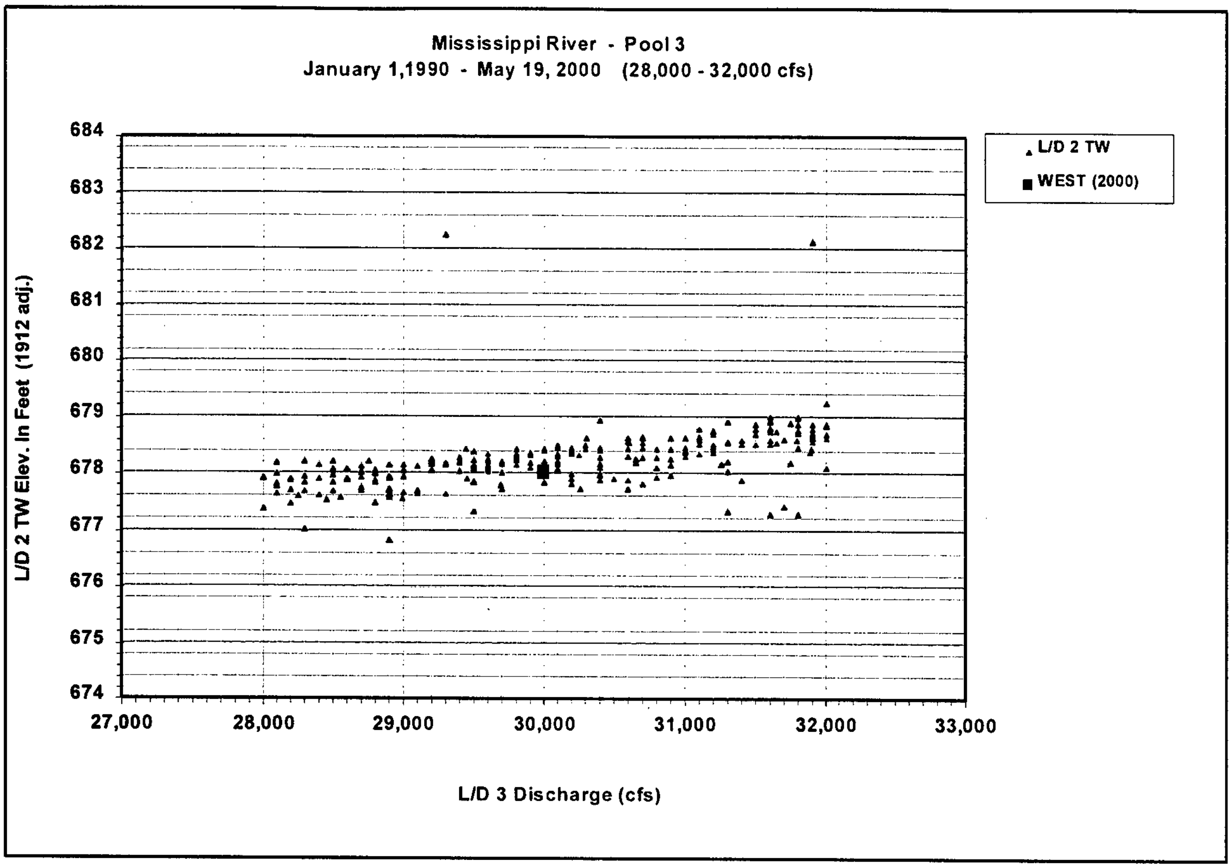

Figure 2-22: Plot of Model WSE vs. Observed Data at L/D 2 Tail Water

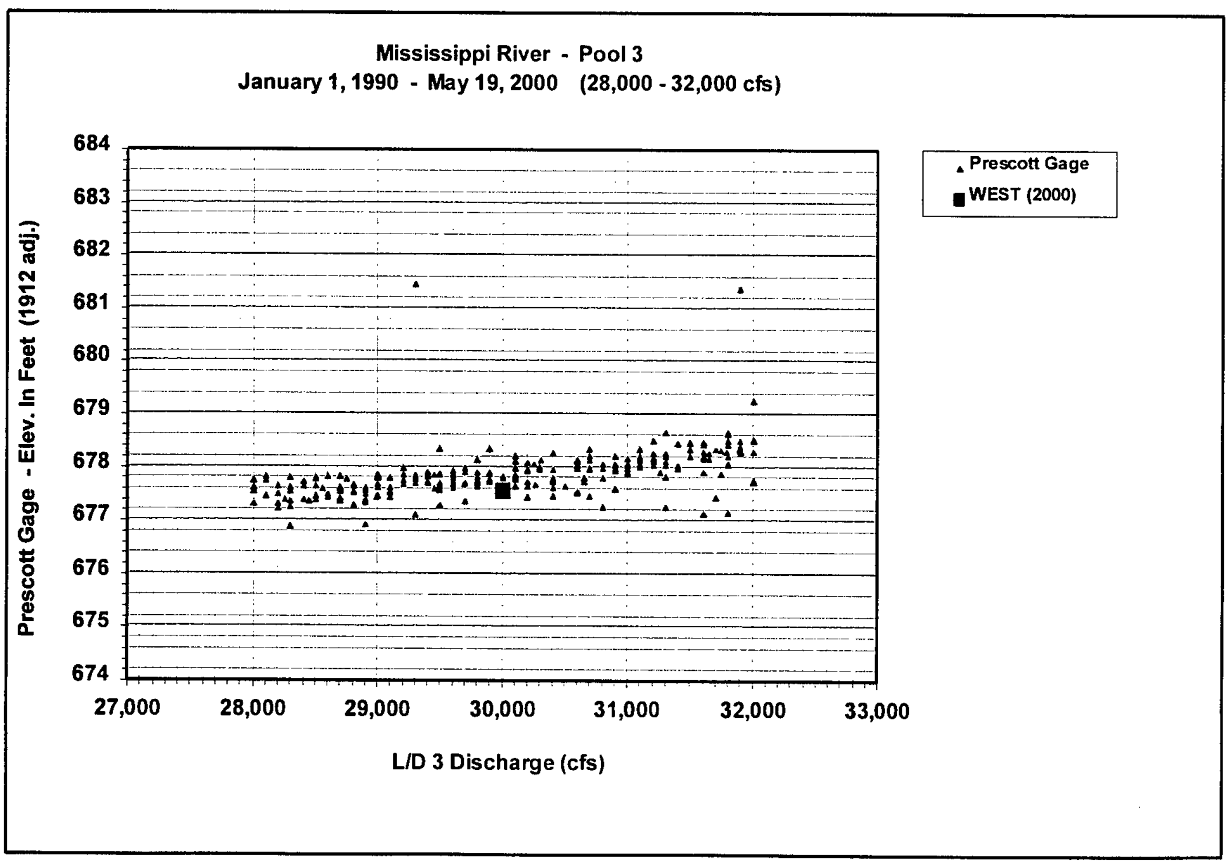

Figure 2-23: Plot of Model WSE vs. Observed Data at Prescott Gage

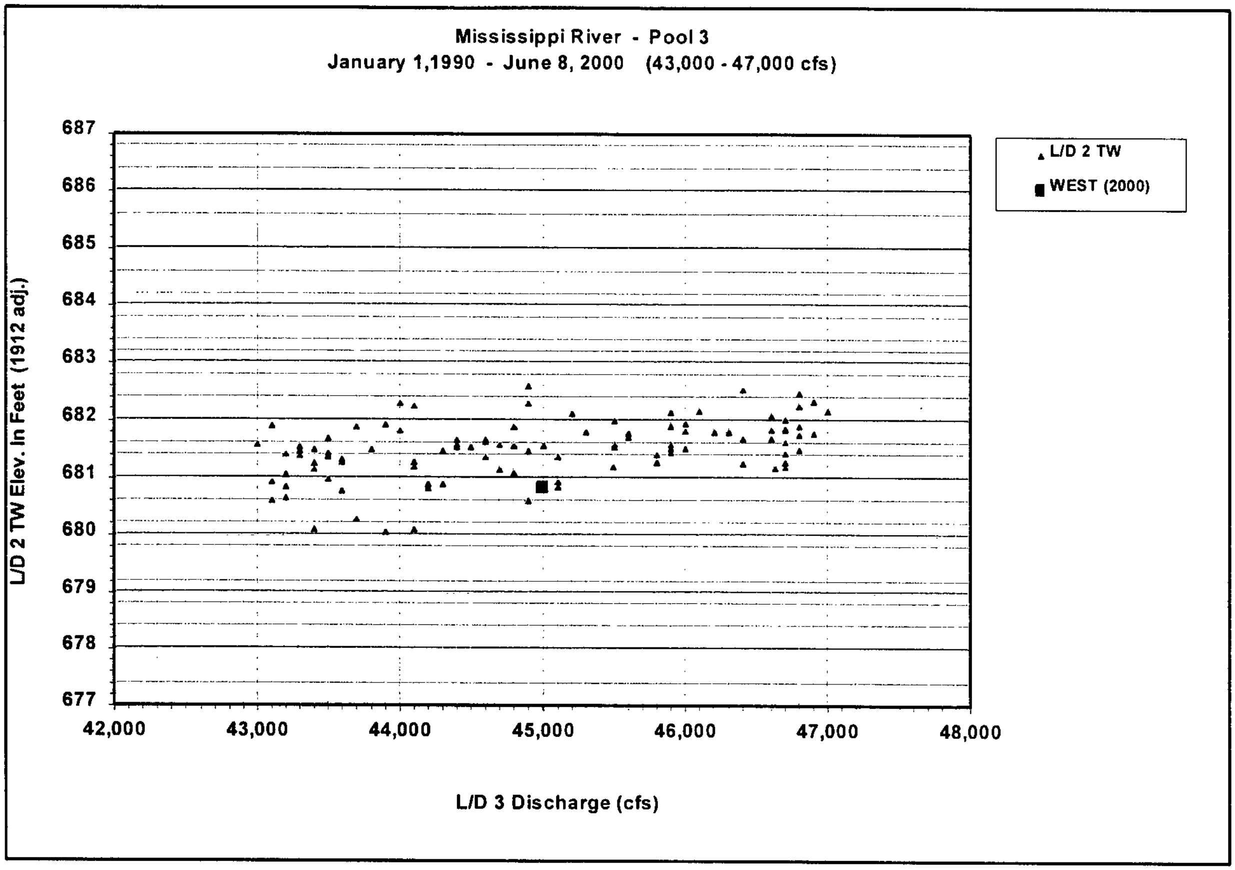

Figure 2-24: Plot of Model WSE vs. Observed Data at L/D 2 Tail Water

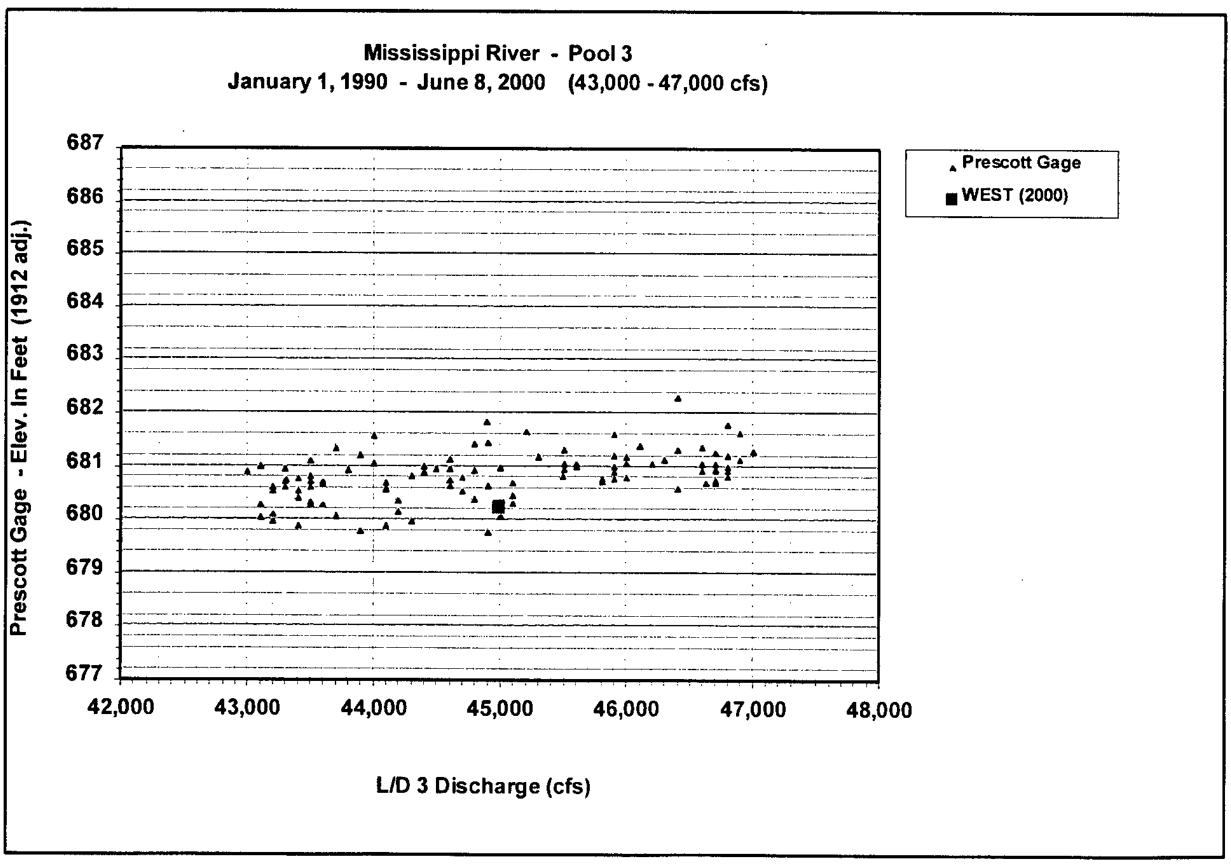

Figure 2-25: Plot of Model WSE vs. Observed Data at Prescott Gage

3 SIMULATION OF DESIGN ALTERNATIVES

3.1 Development of Initial Design Alternatives

Narrative descriptions with supplemental mapping were provided for each of the three initial design alternatives by the District. These alternatives were incorporated into the RMA-2 model using a two-step process. First, the model grid was refined as needed in all area's subject to change as part of the three alternatives. Following the refinement process, the model was run again to assure that no changes in calibration occurred due to the changes in the grid.

Three primary problem areas were selected for proposed modifications and are summarized in Table 3-1.

Table 3-1: Simulated Flows in the Pool 3 Model

Sub-Reach by River Miles	Problem/Proposed River Modification
814.2 - 815.2	Outdraft problem at Lock and Dam 2 and degraded channel habitat on the left side of the main channel / construct dikes or islands to improve conditions
806.9,805.9,804.8	Navigation problems created by navigation channel bends at these three tributaries / realign channel with training structures or by dredging
799.0 - 803.5	High dredging (often by more expensive mechanical dredge equipment) and degraded navigation conditions between RM 800.0 - 801.0 and 801.5 - 802.0/ shift dredging downstream by reducing secondary channel flow through the construction of riffle pool structures in secondary channels. Riffle pool structures would improve aquatic habitat. Constructing wing dams is another option.

For each problem area, three initial design alternatives were selected for evaluation. The design specifications for each alternative are given in Tables 3.2 through 3.4. For each alternative, a model was developed to simulate the proposed conditions. The only variation from the conditions listed in the tables was the selection of a minimum structure top width of approximately 20 ft to avoid model instabilities potentially created by too great a change in grid size.

Table 3-2: Alternative 1 design specifications

For the outdraft problem at the lower approach to Lock and Dam 2 and the degraded channel habitat on the left side of the main channel downstream of Lock and Dam 2, the following is proposed.				
River Modification	**Elevation (1912 adj.)**	**Width (feet)**	**Side Slopes**	**Length (feet)**
Lower Guard Wall Extension at L/D 2, RM 815	Top Elev = 678.5	Top Width = 10	1V:2.5H	600
Barrier Island at RM 814.6	Top Elev = 678.5	Top Width = 100	1V: 5H	970
Channel through barrier island at RM 814.6	No channel is included in Alternative 1			
For the navigation problems created by the bends at the three tributaries that enter from the Wisconsin side of the main channel, the following is proposed.				
River Modification	**Elevation (1912 adj.)**	**Width (feet)**	**Side Slopes**	**Length (feet)**
Wing Dam Rehabilitation at RM 804.9, 805.1, 805.2, 805.2	Top Elev = 671.0	Top Width = 5	1V:2H	As shown on maps
Wing Dam Rehabilitation at RM 807.4 & 807.6	Top Elev = 679.5	Top Width = 5	1V:2H	As shown on maps
For the high dredging volumes and degraded navigation conditions between RM 800.0 - 801.0 and 801.5 - 802.0 dredging will be shifted downstream using the following method.				
River Modification	**Elevation (1912 adj.)**	**Width (feet)**	**Side Slopes**	**Length (feet)**
Partial Closure Structure at RM 801.7 (Brewer Lake inlet)	Bottom Elev = 671.0	Bottom Width = 30'	1V:2.5H	As shown on maps

Table 3-3: Alternative 2 design specifications

For the outdraft problem at the lower approach to Lock and Dam 2 and the degraded channel habitat on the left side of the main channel downstream of Lock and Dam 2, the following is proposed.				
River Modification	**Elevation (1912 adj.)**	**Width (feet)**	**Side Slopes**	**Length (feet)**
Lower Guard Wall Extension at L/D 2, RM 815	Top Elev = 678.5	Top Width = 10	1V:2.5H	1600
Barrier Island at RM 814.6	Top Elev = 678.5	Top Width = 100	1V: 5H	1700
Channel through barrier island at RM 814.6	Bottom Elev = 673.0	Bottom Width = 20	1V:2.5H	-
For the navigation problems created by the bends at the three tributaries that enter from the Wisconsin side of the main channel, the following is proposed.				
River Modification	**Elevation (1912 adj.)**	**Width (feet)**	**Side Slopes**	**Length (feet)**
Wing Dam Rehabilitation at RM 804.9, 805.1, 805.2, 805.3, 805.5	Top Elev = 671.0	Top Width = 5	1V:2H	As shown on maps
Wing Dam Rehabilitation at RM 807.4, 807.6, and 807.8. Closure Structure at RM 807.8	Top Elev = 679.5	Top Width = 5	1V:2H	As shown on maps
For the high dredging volumes and degraded navigation conditions between RM 800.0 - 801.0 and 801.5 - 802.0 dredging will be shifted downstream using the following method.				
River Modification	**Elevation (1912 adj.)**	**Width (feet)**	**Side Slopes**	**Length (feet)**
Partial Closure at RM 801.7 (Brewer Lake Inlet)	Bottom Elev = 671.0	Bottom Width = 20'	1V:2.5H	As shown on maps
Riffle Structures at RM 802.9 (Miley Run)	Bottom Elev = 669.0	N/A	N/A	As shown on maps

Table 3-4: Alternative 3 design specifications

River Modification	Elevation (1912 adj.)	Width (feet)	Side Slopes	Length (feet)
For the outdraft problem at the lower approach to Lock and Dam 2 and the degraded channel habitat on the left side of the main channel downstream of Lock and Dam 2, the following is proposed.				
River Modification	**Elevation (1912 adj.)**	**Width (feet)**	**Side Slopes**	**Length (feet)**
Lower Guard Wall Extension at L/D 2, RM 815	Top Elev = 671.0	Top Width = 10	1V:2.5H	700
Barrier Island at RM 814.6	Top Elev = 678.5	Top Width = 100	1V: 5H	1700
Channel through barrier island at RM 814.6	Bottom Elev = 673.0	Bottom Width = 20	1V:2.5H	-
For the navigation problems created by the bends at the three tributaries that enter from the Wisconsin side of the main channel, the following is proposed.				
River Modification	**Elevation (1912 adj.)**	**Width (feet)**	**Side Slopes**	**Length (feet)**
Wing Dam Rehabilitation at RM 805.1, 805.2, 805.2, 805.3	Top Elev = 671.0	Top Width = 5	1V:2H	As shown on maps
Wing Dam Rehabilitation at RM 807.4, 807.6, and 807.8. Closure Structure at RM 807.8	Top Elev = 677.0	Top Width = 5	1V:2H	As shown on maps
For the high dredging volumes and degraded navigation conditions between RM 800.0 - 801.0 and 801.5 - 802.0 dredging will be shifted downstream using the following method.				
River Modification	**Elevation (1912 adj.)**	**Width (feet)**	**Side Slopes**	**Length (feet)**
Partial Closure at RM 801.7 (Brewer Lake Inlet)	Bottom Elev = 671.0	Bottom Width = 20'	1V:2.5H	As shown on maps
Partial Closure at RM 802.3	Bottom Elev = 671.0	Bottom Width = 20'	1V:2.5H	As shown on maps
Riffle Structures at RM 802.9 (Miley Run)	Bottom Elev = 669.0	N/A	N/A	As shown on maps

A brief description of the river modifications and their anticipated functions is provided below.

The crest elevations of the lower guard wall (alternatives 1 and 2), and the barrier island at RM 814.6 were selected to be just above the water surface elevation of the 30,000 cfs discharge but overtopped approximately 2 to 2.5 ft by the 45,000 cfs discharge to minimize model instabilities due to shallow flow over the structure. A small channel through the barrier island to prevent stagnation behind the island was modeled in alternatives 2 and 3. In alternative 3 the crest elevation of the lower guard wall was decreased to 671.0.

To reduce flow down the secondary channel and improve bathymetric diversity for fish habitat, wing dams at RM 807.4, 807.6, and 807.8 were selected for restoration along with a closure structure at RM 807.8.

Several wing dams were selected for restoration near RM 805 to improve channel conditions. Small notches will be included in the wing dams to create flow and bathymetric diversity.

Riffle structures in Miley Run (RM 802.9) and partial closures of the Brewers Lake Inlet (RM 801.7) and the secondary channel at RM 802.3 were evaluated to stabilize the secondary channels and increase the main channel discharge.

3.2 Simulation of Initial Design Alternatives

A descriptive summary of the modeling results for the three initial design alternatives is provided below. For each of the three alternatives the roughness characteristics were increased to 0.032 for the Lower Guard Wall and 0.039 for the wing dams and Brewers Lake Closure structure.

The only variation from the alternative designs summarized previously was the selection of a minimum top width of approximately 20 ft for the structures. This was done to prevent model instabilities arising from too great a change in grid size. The macro flow characteristics of wing dams and similar structures are primarily shape related and not greatly affected by roughness so this change will have no noticeable effect on model accuracy. This was verified by performing a supplemental series of runs for alternative 1 using the same roughness characteristics as the primary river reaches.

A brief summary of the modeling results for each of the alternatives is provided below. In general the three alternatives showed some localized differences but as expected were similar in many reaches. Highlighted below are conditions for the 45,000 cfs discharge to best relate sediment carrying capacity. The velocities provided are those, which were observed as the typical maximum at any given cross section in the reach indicated. The 10,000 and 30,000 cfs discharges showed similar patterns for each alternative. As seen in Figure 3-1 water surface slopes were similar for all alternatives and compare reasonably with the existing conditions model.

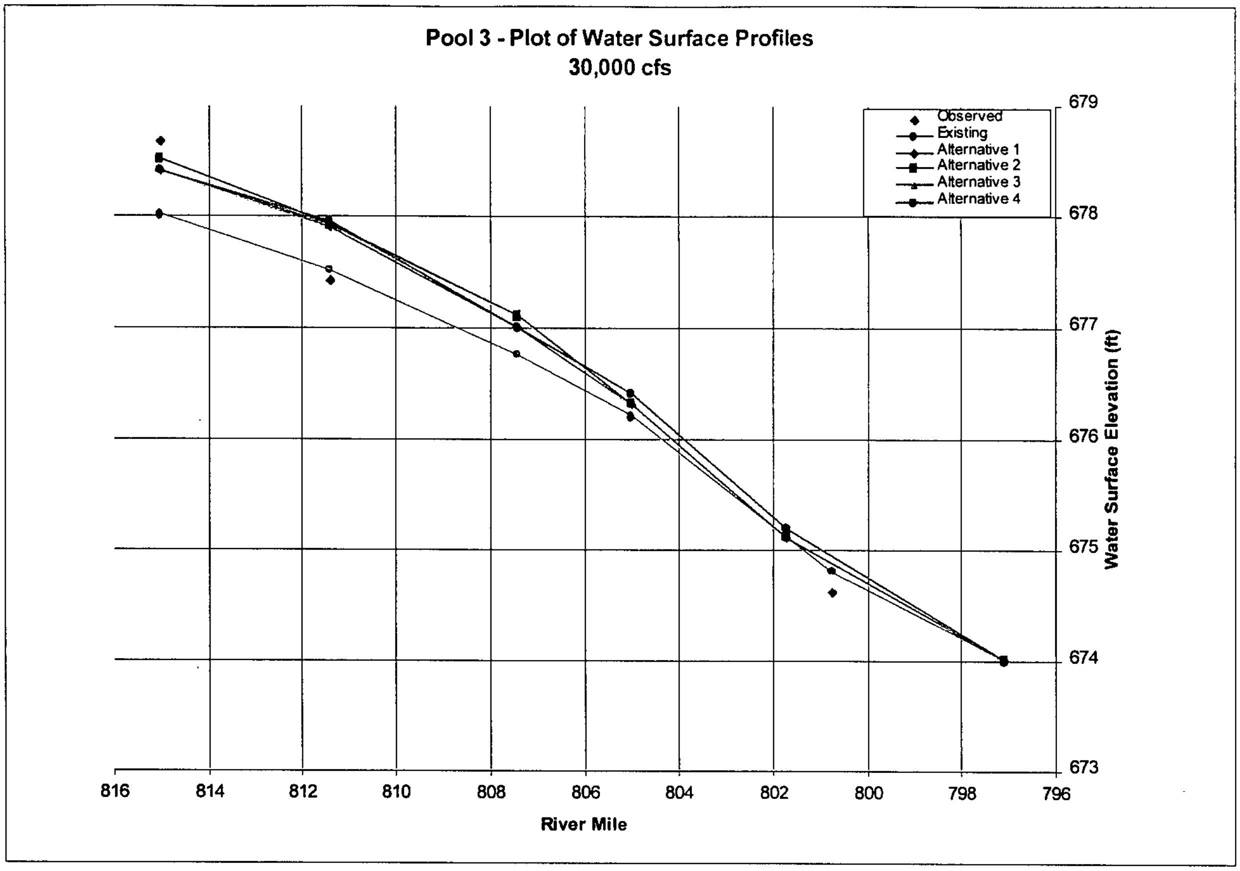

Figure 3-1: Plot of Water Surface Profiles for Observed and Model Conditions

3.2.1 Alternative 1

For the 45,000 cfs flow the typical maximum free stream velocity observed ranged from 2.5 to 3.0 feet per second downstream of Lock and Dam 2. The velocity was 3.0 feet per second plus or minus at RM 807 and increased to between 3.0 to 3.5 ft per second at RM 805. The velocity near RM 802 ranged from 2.0 to 2.5 feet per second.

3.2.2 Alternative 2

Compared to alternatives 1 and 3, alternative 2 (1600 ft lower guard wall extension) increased velocities by about 50% (typical maximum free stream velocity of 3.5 to 4.0 feet per second) in the reach near the end of the guard wall. Other reaches of the river showed velocities similar to those observed for alternative 1.

3.2.3 Alternative 3

Alternative 3 performed similar to alternative 1 with the exception of slightly increasing the velocity to between 3.0 to 3.5 feet per second near RM 807.

The velocity profiles of model alternatives for different flow conditions are shown in Figures 3-2 through 3-4 and the water surface elevation (WSE) profiles are shown in Figures 3-5 through 3-7.

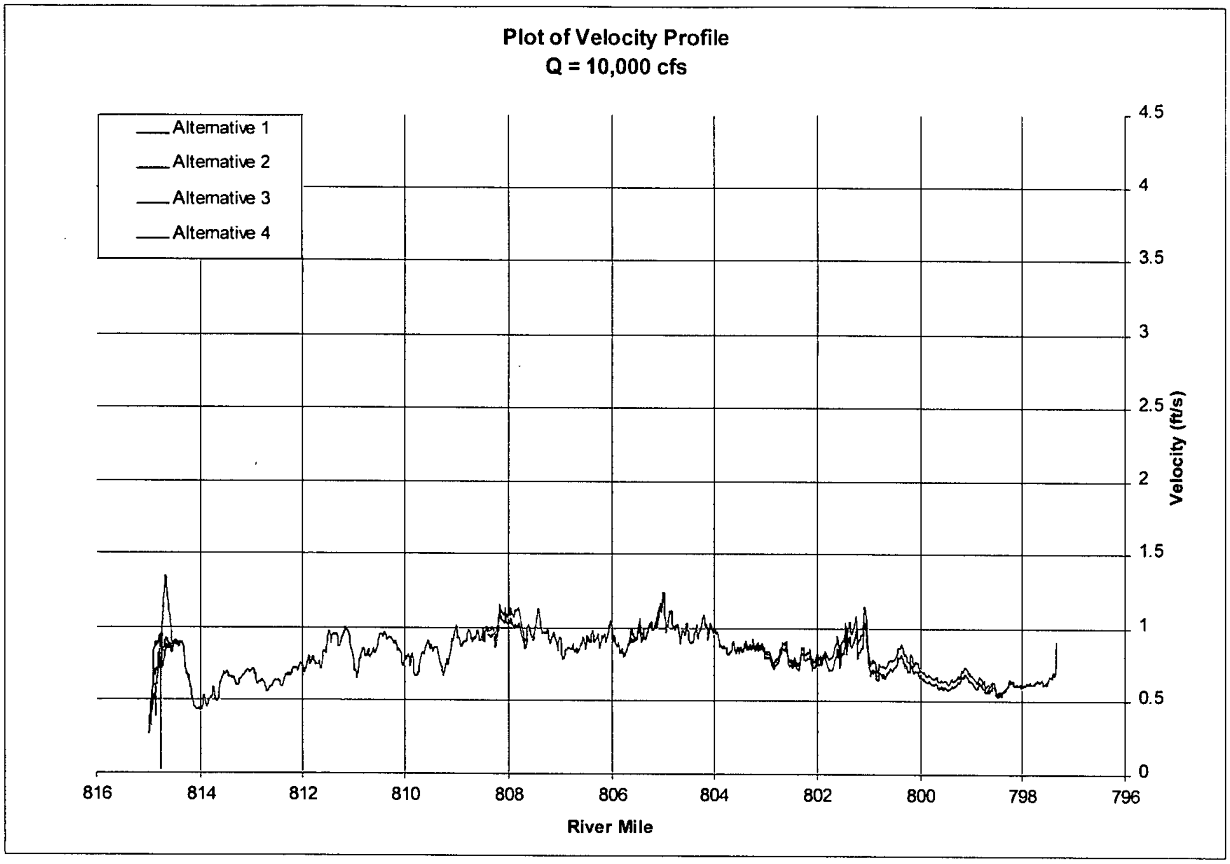

Figure 3-2: Plot of Velocity Profiles for Model Conditions at Low Flow

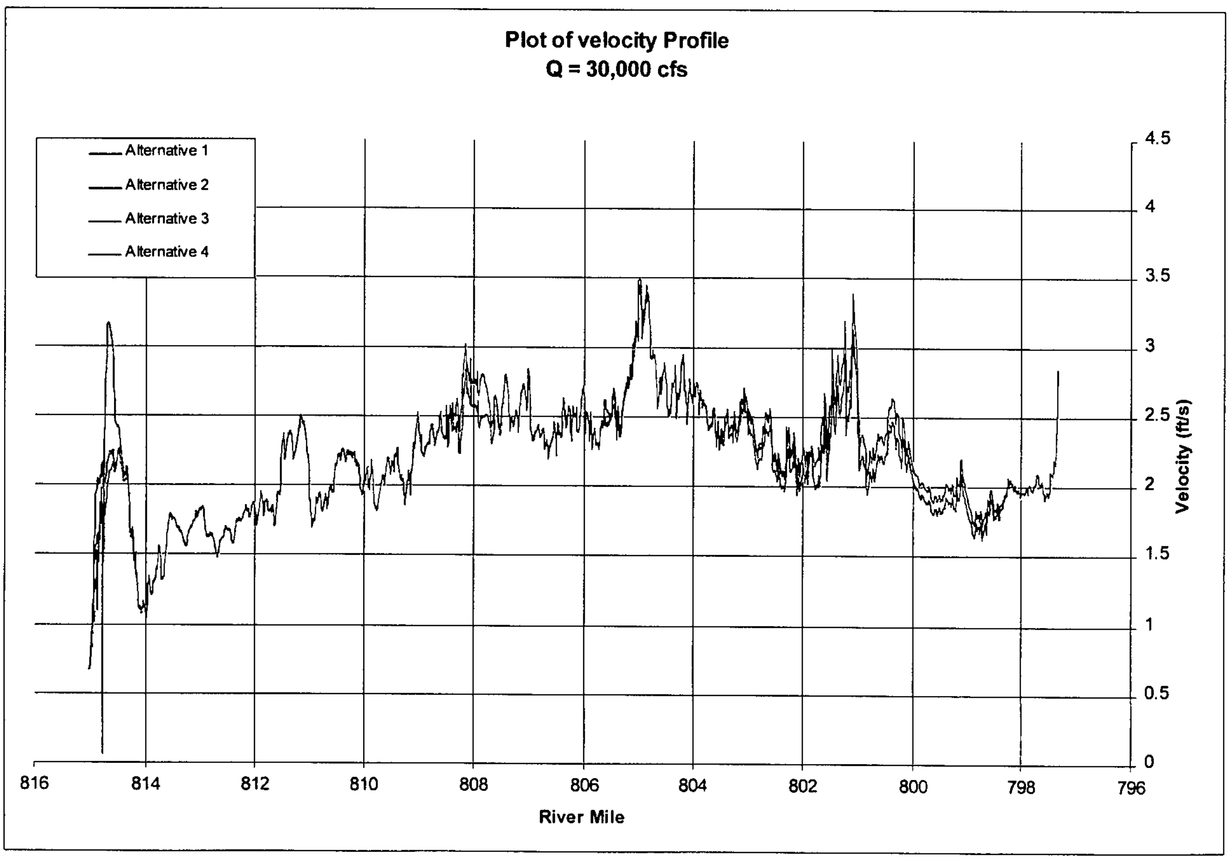

Figure 3-3: Plot of Velocity Profiles for Model Conditions at Medium Flow

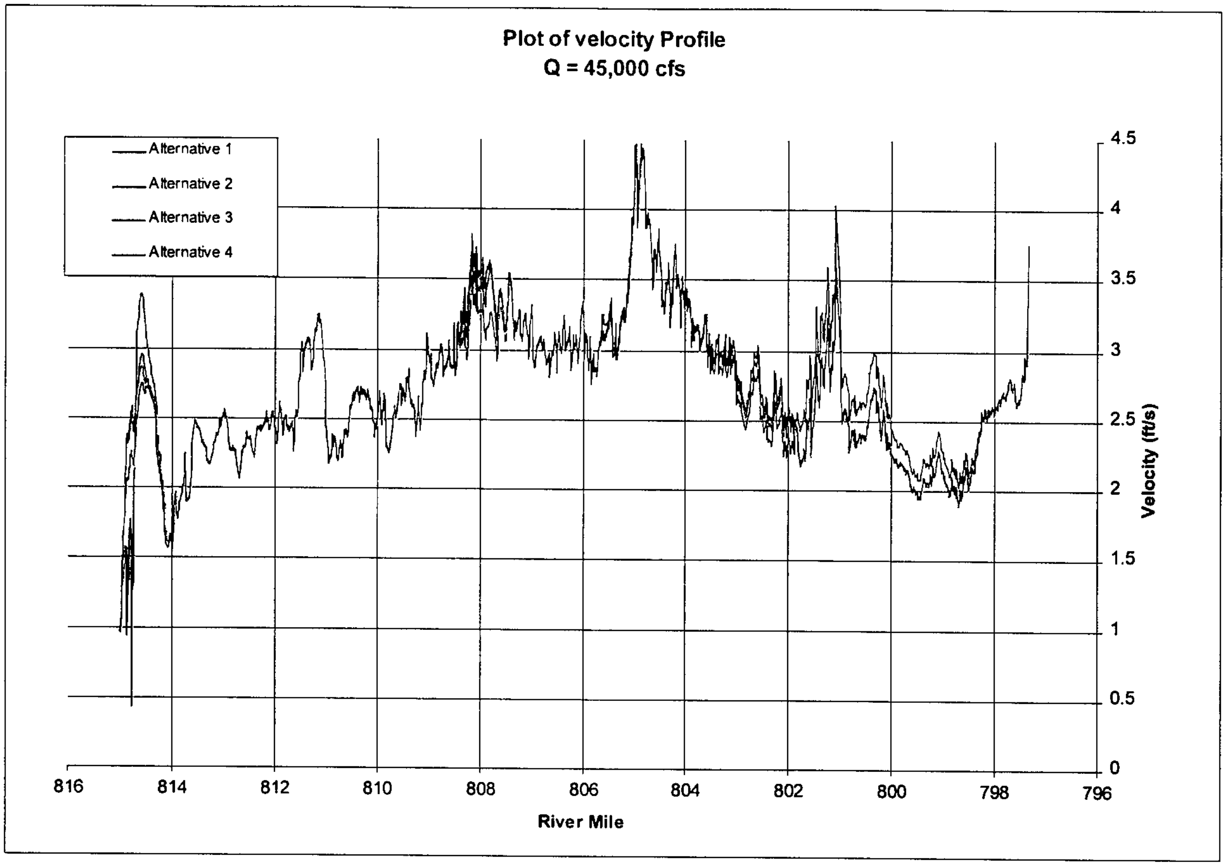

Figure 3-4: Plot of Velocity Profiles for Model Conditions at High Flow

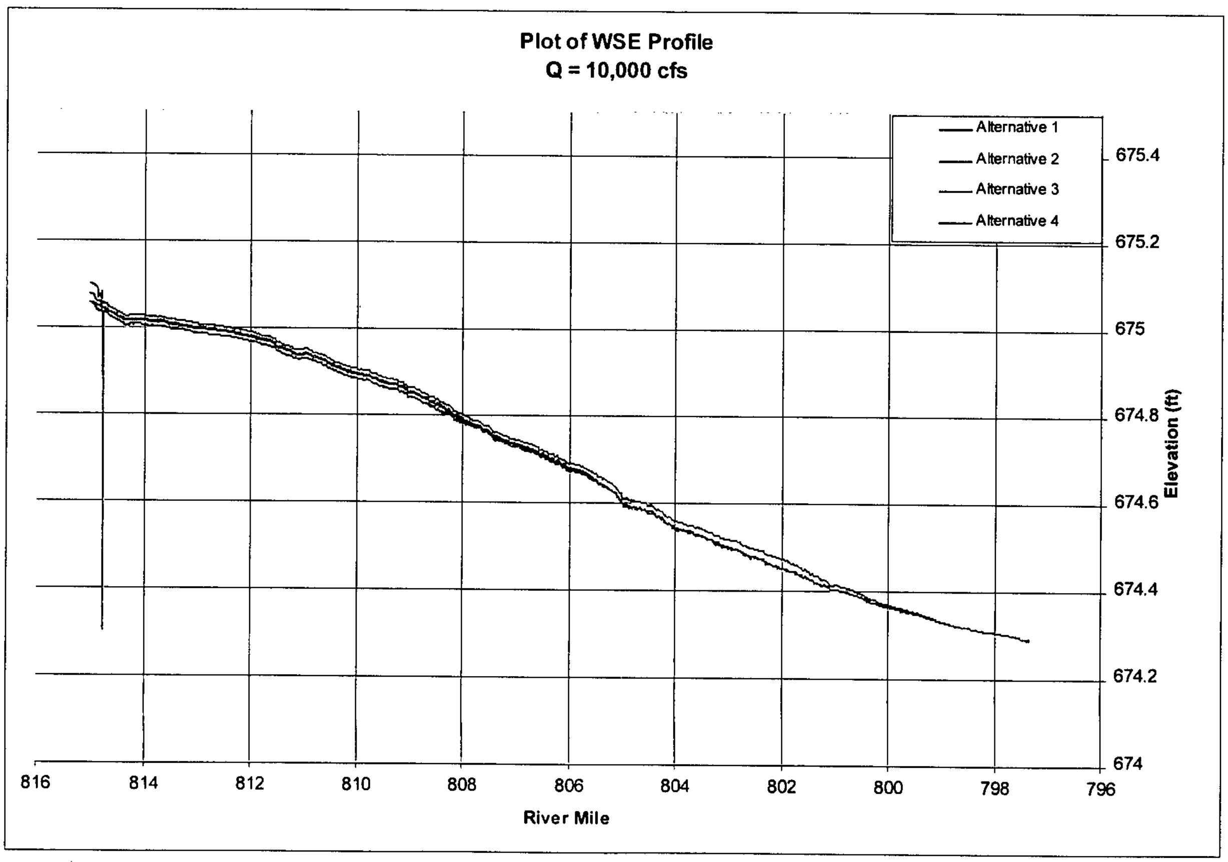

Figure 3-5: Plot of WSE Profiles for Model Conditions at Low Flow

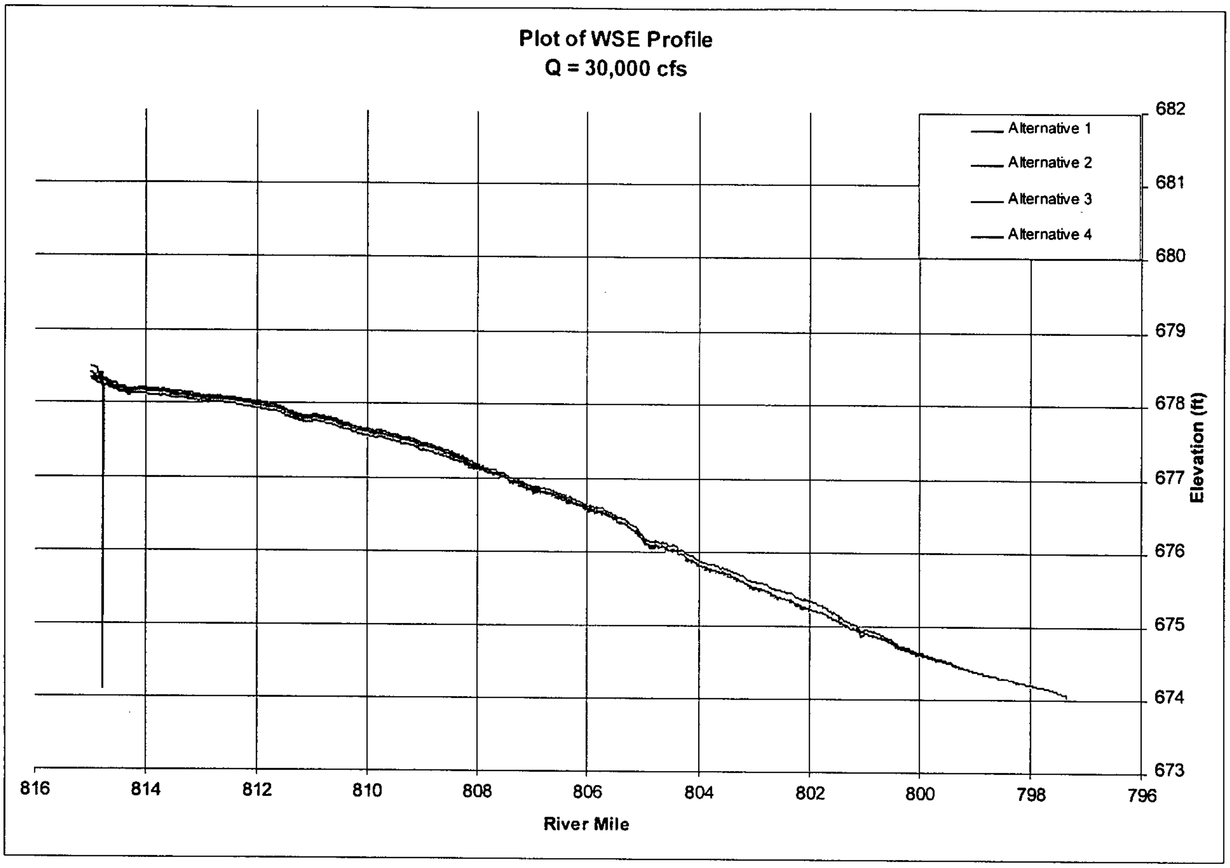

Figure 3-6: Plot of WSE Profiles for Model Conditions at Medium Flow

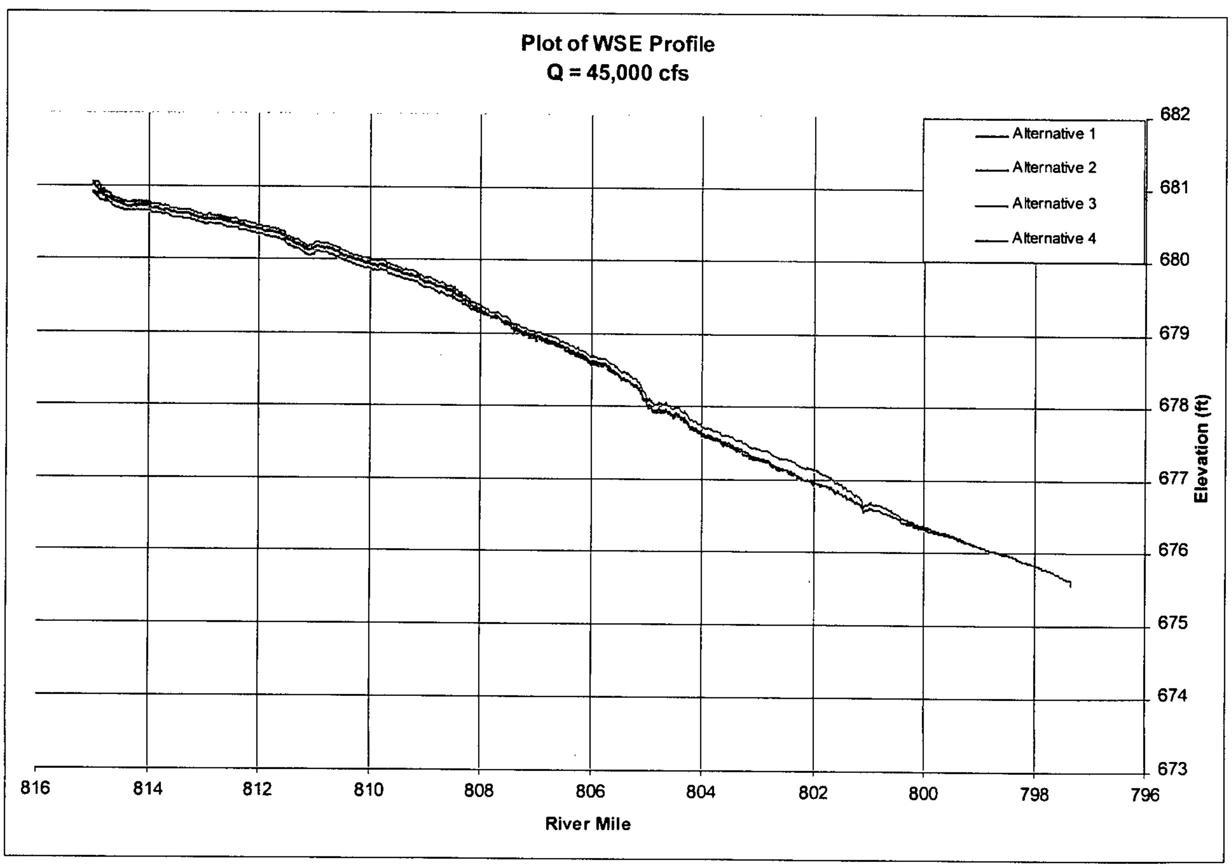

Figure 3-7: Plot of WSE Profiles for Model Conditions at High Flow

3.3 Development of the Final Design Alternative

Following their review, the District provided a fourth and final series of alternatives to be modeled. These alternatives are summarized below in Table 3-5. The final design is a compilation of the most successful design features of alternatives 1 through 3, along with a small longitudinal channel at the Brewers Lake Inlet (RM 801.7) surrounded by higher embankments and an increased bottom elevation for the riffle structures at Miley Run (RM 802.9). The proposed design changes creating the small longitudinal channel within the partial closure at the Brewers Lake Inlet necessitated a much localized grid refinement at that location.

Table 3-5: Alternative 3 design specifications

<table>
<tr><td colspan="5">For the outdraft problem at the lower approach to Lock and Dam 2 and the degraded channel habitat on the left side of the main channel downstream of Lock and Dam 2, the following is proposed.</td></tr>
<tr><td>River Modification</td><td>Elevation (1912 adj.)</td><td>Width (feet)</td><td>Side Slopes</td><td>Length (feet)</td></tr>
<tr><td>Lower Guard Wall Extension at L/D 2, RM 815</td><td>Top Elev = 678.5</td><td>Top Width = 10</td><td>1V:2.5H</td><td>600</td></tr>
<tr><td>Barrier Island at RM 814.6</td><td>Top Elev = 678.5</td><td>Top Width = 100</td><td>1V: 5H</td><td>1700</td></tr>
<tr><td>Channel through barrier island at RM 814.6</td><td>Bottom Elev = 673.0</td><td>Bottom Width = 20</td><td>1V:2.5H</td><td>-</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="5">For the navigation problems created by the bends at the three tributaries that enter from the Wisconsin side of the main channel, the following is proposed.</td></tr>
<tr><td>River Modification</td><td>Elevation (1912 adj.)</td><td>Width (feet)</td><td>Side Slopes</td><td>Length (feet)</td></tr>
<tr><td>Wing Dam Rehabilitation at RM 804.9, 805.1, 805.2, 805.2</td><td>Top Elev = 671.0</td><td>Top Width = 5</td><td>1V:2H</td><td>As shown on maps</td></tr>
<tr><td>Wing Dam Rehabilitation at RM 807.4, 807.6, and 807.8. Closure Structure at RM 807.8</td><td>Top Elev = 679.5</td><td>Top Width = 5</td><td>1V:2H</td><td>As shown on maps</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="5">For the high dredging volumes and degraded navigation conditions between RM 800.0 - 801.0 and 801.5 - 802.0 dredging will be shifted downstream using the following method.</td></tr>
<tr><td>River Modification</td><td>Elevation (1912 adj.)</td><td>Width (feet)</td><td colspan="2">Length (feet)</td></tr>
<tr><td>Partial Closure at RM 801.7 (Brewer Lake Inlet)</td><td>Bottom Elev = 678.0</td><td>20'</td><td colspan="2">A small channel will be left in the middle of the closure. The bottom width of this channel (as you look d/s into Brewer L.) will be 20 feet. The bottom elevation is 671.0 and the side slopes will be 1V:2.5H.</td></tr>
<tr><td>Partial Closure at RM 802.3</td><td>Bottom Elev = 671.0</td><td>20'</td><td colspan="2">Length as shown on previously provided diagrams. There is no change here from Alternative 3</td></tr>
<tr><td>Riffle Structures at RM 802.9 (Miley Run)</td><td>Bottom Elev = 671.0</td><td>N/A</td><td colspan="2"></td></tr>
</table>

3.4 Simulation of the Final Design Alternative

The final design alternative shows a typical maximum free stream velocity just downstream from the lock of about 2.8 feet per second at 45,000 cfs discharge. Near RM 807 the velocity stays above 3.0 feet per second and generally ranges from 3.2 to 3.5 feet per second. These velocities are maintained downstream to RM 805 where the velocities were 3.0 to 3.1 feet per second. River velocities slow near Miley Run and the Brewers Lake Inlet approximately RM 802, but maintain a minimum velocity of 2.4 feet per second through the reach. This is an improvement

of about 20% from the earlier runs and is related to the approximately 10% relative increase in main channel discharge from the earlier runs.

Figure 3-1 compares the longitudinal water surface elevation profile of alternative 4 with other existing and observed model conditions. Figure 3-8 summarizes the comparison of longitudinal distribution of flows in the main channel and various side channels between the different model conditions, for a flow of 30,000 cfs at L&D3. Table 3-6 summarizes the discharges at 17 different continuity strings at various locations along the reach.

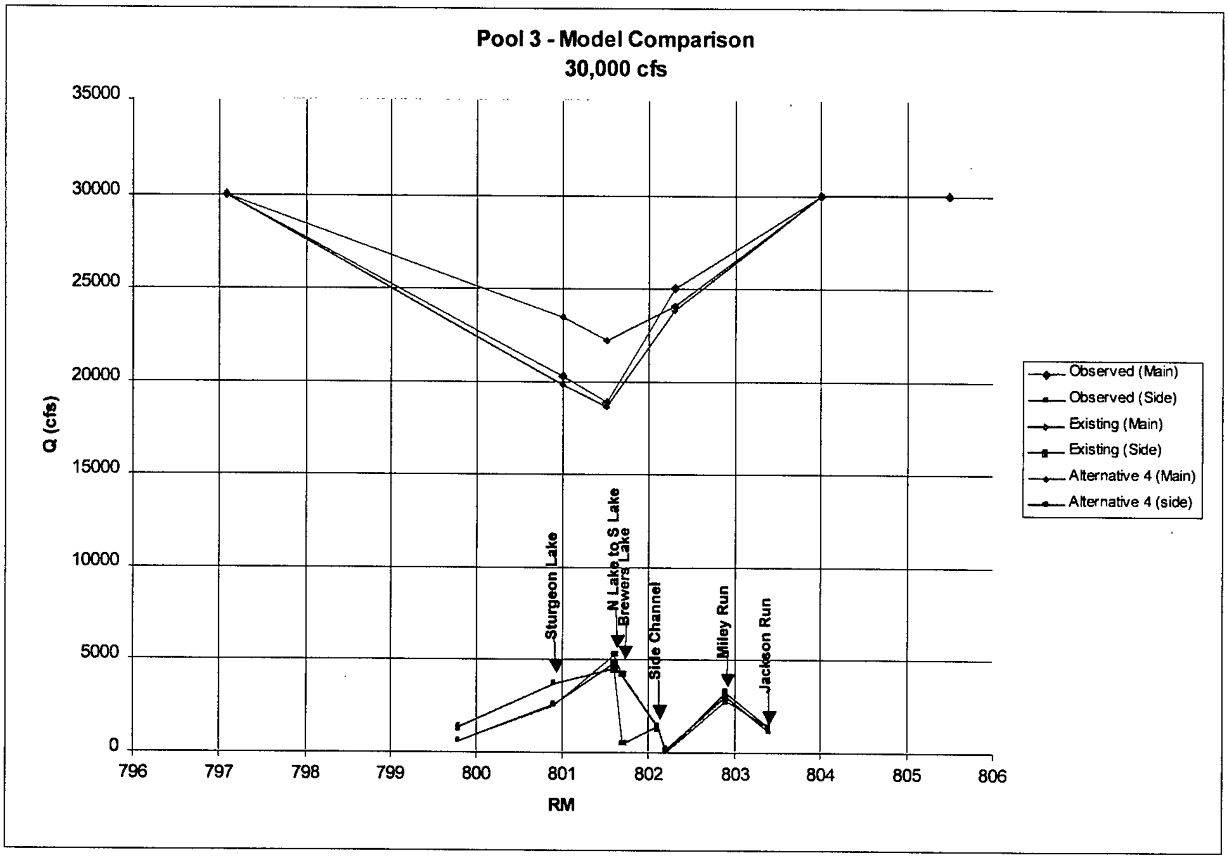

Figure 3-8: Comparison of Alternative 4 with Existing and Observed Conditions

Table 3-6: Percentage of Discharges at Various Locations in Pool 3

Continuity String	Description	A1-L	A2-L	A3-L	A4-L	A1-M	A2 M	A3-M	A4-M	A1-H	A2-H	A3-H	A4-H
1	L&D 3	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
2	St.Croix	20.8	20.8	20.7	20.8	22.6	22.6	22.6	22.6	20.2	20.2	20.2	20.2
3	L&D 2	80.5	80.5	80.4	80.5	77.4	77.4	77.4	77.4	79.8	79.8	79.8	79.8
4	M.C. 807	103.5	103.5	103.5	103.5	93.0	93.0	93.0	93.0	102.1	102.1	102.1	102.1
5	M.C. 805	99.3	99.3	99.3	99.3	100.0	100.1	100.0	100.0	100.3	100.4	100.4	100.3
6	Uppermost inlet, right 803+	3.7	3.8	3.8	4.8	2.9	3.0	3.0	3.7	5.8	6.1	6.1	7.3
7	Miley Run	7.4	6.6	6.6	8.3	9.2	8.2	8.2	10.0	11.7	10.0	10.0	11.4
8	M.C. 802.5	83.6	84.3	84.3	80.9	82.5	83.3	83.3	80.1	76.8	78.2	78.2	74.9
9	Left side channel, 802.3	3.2	3.2	3.2	3.4	4.3	4.4	4.3	4.7	6.6	6.6	6.6	7.1
10	Right side inlet, 802.2	0.1	0.1	0.1	0.3	0.2	0.3	0.3	0.5	0.3	0.3	0.3	0.8
11	Between upper and lower lakes	12.7	12.1	12.1	15.0	13.1	12.5	12.5	15.1	18.2	17.2	17.2	20.1
12	Brewer Lake Inlet	11.7	12.1	12.1	1.1	10.7	11.3	11.3	1.5	12.2	13.1	13.1	1.7
13	M.C. 801.3	69.2	69.4	69.4	76.6	68.0	68.2	68.2	74.1	57.5	57.9	58.0	64.8
14	M.C. 800.8	72.9	73.1	73.1	80.5	71.9	72.1	72.1	78.3	64.7	65.2	65.2	72.7
15	Right side inlet 800.7	10.4	10.5	10.5	12.5	10.5	10.5	10.5	12.4	9.8	9.9	9.9	12.1
16	Right side inlet 800	3.0	3.1	3.1	4.3	3.0	3.1	3.1	4.4	1.9	2.0	2.0	3.9
17	Back channel pocket 800	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1

4 DISCUSSION

The hydrodynamic modeling of Pool 3 on the Upper Mississippi River evaluated over twenty possible channel modifications for three different flow conditions. Broken into three design development alternatives and a final design alternative. Possible modifications to the pool to improve maintenance and increase bathymetric diversity were evaluated at the upper, middle and lower reaches of pool 3.

The water surface slopes for all four alternatives reasonably match existing conditions. The selected alternatives for final design meet the objectives outlined at the start of the study. An increase in bathymetric diversity is achieved in each reach selected for modification in the pool. Alternative 4 increases the main channel discharge in the lower reaches of pool 3 to a level better able to maintain sediment carrying capacity.

5 REFERENCES

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Thomas, W. A. and McAnally, W.H., Jr. 1991. "Users' manual for the generalized computer program system: Open channel flow and sedimentation, TABS-2," Instruction Report HL-85-1, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

Upper Midwest Environmental Sciences Center (UMESC). Land/Water, UMRS Floodplain, derived from UMESC web site (http://emtc.nbs.gov). 1999.

U.S. Army Corps of Engineers, Waterways Experiment Station (WES), Hydraulics Laboratory, 1996. "Users Guide to RMA2 Version 4.3", Vicksburg, MS.

APPENDIX D

Section 404(b)(1) Evaluation

SECTION 404(b)(1) EVALUATION

POOL 3/UPPER POOL 4 CHANNEL MANAGEMENT STUDY
POOL 3/UPPER POOL 4, UPPER MISSISSIPPI RIVER

I. PROJECT DESCRIPTION

A. Location

The proposed activities would occur at various locations throughout pool 3 and upper pool 4, Upper Mississippi River. The specific location of each activity is summarized in tables 1 and 2.

B. General Description

This evaluation addresses the impacts resulting from the placement of fill or dredged material in waters of the United States, in compliance with Section 404 of the Clean Water Act. The following actions are being recommended for implementation as part of the Pool 3/Upper Pool 4 Channel Management Study:

- **Notch 19 wing dams** – The proposed notches will increase habitat diversity and productivity. Material removed from each wing dam will be used for any of the following features as determined appropriate by the On-Site Inspection Team: rock mounds or bars downstream or upstream of the present structures; rock groins or vanes for stabilizing adjacent shorelines; wing extensions perpendicular to the existing structures (upstream or downstream); placement elsewhere on the existing structures to increase bathymetric and flow diversity.

  Alternatives to notching 19 wing dams - The alternative to these placement options would be to haul the material to a dredged material placement site. However, this alternative was not chosen because it would not provide the additional environmental benefits of bank stabilization or increased bathymetric and flow diversity that the chosen alternatives would. The other alternative would be that of no-action; however, this would not meet the goals and objectives of the project.

- **Rehabilitate four wing dams (804.9L, 805.1L, 805.2L, 805.25L)** – The proposed wing dam rehabilitations would increase the safety and navigability of the affected reach. Notching two of those wing dams (805.1L and 805.2L) would maintain habitat diversity and productivity.

  Alternative to rehabilitating four wing dams - The only alternative to the chosen action would be that of no action, which would not meet the goals and objectives of the project.

- **Construct a new spot dike at Carter Slough (river mile 807.3)** – The proposed spot dike construction would eliminate bypass flows. This would thereby help maintain pool 3 and prevent habitat degradation in Mud Hen Lake.

Alternatives to constructing a new spot dike at Carter Slough – One alternative would be to repair the spot dike in its original location. However, construction in this area would require more access dredging and would negatively impact a larger area. The other alternative to the chosen action would be that of no action, which would not meet the goals and objectives of the project.

The proposed fill or dredge material placement activities are summarized in tables 1 and 2.

Table 1. Summary of wing dam notches for the Pool 3 Channel Management Study.

Project Feature	Location	Sand & rock (cy)	Notch width (ft)
Wing dam 809.5R notch	RM 809.5 right bank	380	100
Wing dam 809.4R notch	RM 809.4 right bank	136	20
Wing dam 809.3R notch	RM 809.3 right bank	90	10
Wing dam 807.8R notch	RM 807.8 right bank	185	50
Wing dam 807.6R notch	RM 807.6 right bank	16	30
Wing dam 807.4R notch	RM 807.4 right bank	54	50
Wing dam 807.3R notch	RM 807.3 right bank	38	30
Wing dam 806.1L notch	RM 806.1 left bank	129	15
Wing dam 801.7L notch	RM 801.7 left bank	84	15
Wing dam 801.6L notch	RM 801.6 left bank	35	20
Wing dam 801.4L notch	RM 801.4 left bank	208	15
Wing dam 800.6R notch	RM 800.6 right bank	82	10
Wing dam 800.4R notch	RM 800.4 right bank	46	20
Wing dam 800.3R notch	RM 800.3 right bank	63	10
Wing dam 800.0L notch	RM 800.0 left bank	31	10
Wing dam 799.8L notch	RM 799.8 left bank	31	10
Wing dam 799.7L notch	RM 799.7 left bank	31	10
Wing dam 797.6L notch	RM 797.6 left bank	113	20
Wing dam 797.5L notch	RM 797.5 left bank	113	20

Table 2. Summary of wing dam restorations and spot dike creation in pool 3.

Project Feature	Location	Rock (cy)
Wing dam 804.9L	RM 750.0 left bank	326
Wing dam 805.1L	RM 748.0 left bank	228
Wing dam 805.2L	RM 748.0 left bank	246
Wing dam 805.25L	RM 746.6 left bank	255
Carter Slough spot dike	RM 807.3 right bank	430
Total		1485

C. Authority and Purpose

The River and Harbor Act of July 3, 1930 authorized a 9-foot channel navigation project on the Upper Mississippi River. The proposed modification/restoration of control structures would be conducted under this authority. The purpose of these channel control structure projects are to reduce or control dredging requirements, maintain the navigation pool, improve navigation safety, reduce adverse environmental effects of existing channel control structures, and restore natural river processes and functions as much as possible.

D. General Description of Dredged or Fill Material

1. General Characteristics of Material

Material removed from the wing dams to create notches would likely be mostly rock with some sand and remnant willows that were used in the initial construction. The rock used for spot dike construction and wing dam restoration would be the standard quarry run rock. Material dredged for equipment access to the Carter Slough spot dike has not been sampled but is likely sand and silt.

2. Quantity of Material

The quantity of material for each project is summarized in tables 1 and 2. Construction of the spot dike may require some dredging to provide equipment access. It is estimated that as much as 5000 cubic yards may be dredged, although construction during high water would reduce this quantity.

Notching of the wing dams or other structural modifications would occur during high water, eliminating the need for access dredging.

3. Source of Material

Rock would be obtained from any of several active quarries located in the vicinity.

E. Description of the Proposed Discharge Sites

1. Location

The locations of the project features are summarized in tables 1 and 2. Material dredged from Carter Slough to provide equipment access would be barged to a long-term upland disposal site approved in the Channel Maintenance Management Plan (CMMP).

2. Size

The rehabilitation of wing dam 804.9L would impact around 0.22 acres of existing wing dam habitat. Around 0.20, 0.15, and 0.10 acres of existing wing dam habitat would be impacted by the modifications of wing dams 805.1L, 805.2L, and 805.25L, respectively. The spot dike at Carter Slough would cover around 0.10 acres of existing substrate. The placement of material notched from the 19 wing dams would likely cover around 0.01 to 0.14 acres of aquatic and/or terrestrial habitat at each site.

3. Type of Site

The area where the spot dike would be placed in Carter Slough is likely sand and silt habitat. The wing dam notching and rehabilitation sites are predominately rock habitat that have either been buried by sand or have degraded since initial construction.

4. Types of Habitat

The wing dam notching and rehabilitation sites are either main channel border habitat or secondary channel habitat. The Carter Slough spot dike would be in secondary channel habitat, which is currently blocked by debris and is likely providing low-quality lotic habitat.

F. Description of Disposal Method

All material from wing dam notching, wing dam restoration, and Carter Slough spot dike construction, including access dredging, would be handled mechanically by a barge-mounted crane.

II. FACTUAL DETERMINATIONS

A. Physical Substrate Determinations

1. Substrate Elevation and Slope

Wing dams 804.9L, 805.1L, 805.2L, and 805.25L would have a top-width of 5 feet, top elevations of 671 feet above mean sea level, and side slopes of 1 vertical on 2 horizontal.

The Carter Slough spot dike would have a 1 vertical on 2 horizontal front slope and a 1 vertical on 3 horizontal back slope. Its top width would be about 25 feet, and its top elevation would be about 679 feet above mean sea level (about 3.5 feet above low control pool).

2. Sediment Type

The substrate at wing dams proposed for notching or modifications consists of predominately rock, with some sand. The substrate that would be covered by the spot dike at Carter Slough has not been sampled but is likely to consist of sand and silt. The material dredged for equipment access would also likely consist of sand and silt.

3. Dredged/Fill Material Movement

The wing dams are being notched to cause a scour hole to develop and/or to deepen secondary channels. Sand material that is eroded at these sites would become a relatively small portion of the bed load moving in the main channel border. Some of the rock removed from the wing dams may be used to stabilize existing shorelines.

Initially, the Carter Slough spot dike would cause the formation of a scour hole on its downstream side during high water. However, it would reduce erosion and sediment transport in the slough. The material used to construct the dike would be stable.

4. Physical Effects on Benthos

Any organisms in the fill areas for the proposed structural modifications and spot dike creation would be covered. The newly created rock substrate would quickly colonize with benthos.

The area to be dredged for access to construct the spot dike should quickly re-colonize upon project completion. However, Carter Slough would experience a loss in flows during normal river discharges that would either eliminate much of its benthic habitat or convert it to a more lentic condition.

Mussel surveys were conducted in 1994 and 2000 in the areas proposed for construction activities, except the Carter Slough spot dike (the slough was blocked by a log jam). Only commonly occurring species were encountered in most of the surveys. No federally-listed species were collected and only two individuals of a Minnesota-listed species (*Obovaria olivaria*) were collected.

5. Actions Taken to Minimize Impacts

No special actions would be taken to minimize adverse impacts on the substrate.

B. Water Circulation, Fluctuation, and Salinity Determination

1. Water

a. Salinity

Not applicable.

b. Water Chemistry

The use of clean fill materials should preclude any significant impacts on water chemistry.

c. Clarity

Some minor, short-term decreases in water clarity are expected from the proposed fill activities. Dredging of fines would be expected to result in localized decreases in water clarity. The long-term effect from fill placement in Carter Slough should help prevent an increase in sediment-derived turbidity in Mud Hen Lake. However, the related increase in residence time could cause an increase in algal productivity that would decrease water clarity.

d. Color

The proposed fill activities should have no effect on water color.

e. Odor

The proposed fill activities should have no effect on water odor.

f. Taste

The proposed fill activities should have no effect on water taste.

g. Dissolved Oxygen Levels

The proposed fill activities may cause a decrease in winter dissolved oxygen levels in Mud Hen Lake. However, it is not believed that this would lead to fish kills. There should be no effect on other habitats in pool 3 / upper pool 4.

h. Nutrients

The proposed fill activities should have no effect on nutrient levels in the water.

I. Eutrophication

The proposed fill activities may decrease the rate of eutrophication in Mud Hen Lake. There should minimal or no effect on other habitats in pool 3 / upper pool 4.

j. Temperature

The proposed fill activities may cause a slight increase in winter water temperatures in Mud Hen Lake. There should be no effect on other habitats in pool 3 / upper pool 4.

2. Current Patterns and Circulation

a. Current Velocity and Patterns

Notching wing dams 807.8R, 807.6R, 807.4R, and 807.3R would increase flow through this secondary channel. The large notch in wing dam 809.5R could increase flow over wing dams 809.4R and 809.3R, and may improve the effectiveness of their notches. The remaining wing dam notching sites would not cause significant changes in flow patterns in the main channel border, but only localized increases in flow and current velocity in and adjacent to the notch. The proposed restoration of wing dams 804.9L, 805.1L, 805.2L, and 805.25L would modify current patterns. A slight increase in current velocities would occur in the main channel habitat, coupled with a slight decrease in current velocities in the main channel border habitat where the wing dams are located.

The spot dike would eliminate flow in Carter Slough during normal river discharges. During flood events, flows would enter the slough after topping the spot dike, which would be built at an elevation lower than the surrounding land.

b. Stratification

The proposed fill activities should have no effect on stratification conditions.

c. Hydrologic Regime

The proposed project would not significantly alter the existing hydrologic regime within pool 3 / upper pool 4. The spot dike in Carter Slough would reduce the connectivity of Mud Hen Lake with the main river system.

3. Normal Water Level Fluctuations

The proposed fill activities would have no effect on normal water level fluctuations in main channel, main channel border, and most side channel and backwater habitats. However water levels would be decreased in Carter Slough.

4. Salinity Gradient

Not applicable.

5. Actions Taken to Minimize Impacts

No special actions would be taken to minimize the effects of the proposed project on current patterns or flow.

C. Suspended Particulate/Turbidity Determination

1. Expected Changes in Suspended Particulates and Turbidity Levels in the Vicinity of the Disposal Site

Minor increases in suspended particulates would occur from placement of rock at the proposed rehabilitation or modification of channel control structures. Mechanical dredging for equipment access to the Carter Slough spot dike site would cause a localized increase in turbidity. Turbidity would return to normal at project sites upon completion of construction activities. Sediment-derived turbidity levels would be maintained or decreased in Mud Hen Lake upon completion of the spot dike.

2. Effects on Chemical and Physical Properties of the Water Column

Structure modification/construction would result in localized turbidity plumes. Related short-term effects of this would be decreased light penetration and reduced aesthetics near construction sites. Suspended particulates are not expected to cause a change in dissolved oxygen, toxic metals, organisms, or pathogens of the water column after the project is in place.

The Carter Slough spot dike will reduce the amount of sediment entering Mud Hen Lake, thereby maintaining or reducing turbidity levels there. This would increase the clarity and the aesthetics of the lake. However, if the decrease in residence time leads to an increase in phytoplankton productivity, clarity and the aesthetics of the lake may be reduced. Suspended particulates are not expected to cause a change in dissolved oxygen, toxic metals, organisms, or pathogens in Mud Hen Lake after the project is in place.

3. Effects on Biota

The Carter Slough spot dike should reduce the amount of sediment entering Mud Hen Lake. This would prevent vegetation losses that would occur with increasing turbidity. Temporary increases in turbidity near the channel structure modification/rehabilitation sites would have a minor effect on fish by impairing feeding activity or causing them to temporarily leave the area. These localized short-term increases in turbidity would not likely affect mussels.

4. Actions Taken to Minimize Impacts

Access dredging to the Carter Slough spot dike site would be done mechanically. Also, this action would likely take place during high water to minimize the amount of material that would need to be excavated.

D. Contaminant Determinations

Only relatively old sediment quality data are available for the main channel near Carter Slough. Results of the analysis are shown in Table 3. Contaminants of concern were found to be comparable to those of other main channel sediments of the Upper Mississippi River. No pesticides or PCBs were detected. Sand sediments in Carter Slough would be expected to have similar concentrations of contaminants as those found in the main channel. Contaminant data for fine sediments is not available for Carter Slough. Any material dredged from Carter Slough would be barged to a dredge material placement site approved in the CMMP. Prior to construction of the spot dike, the need for sediment contaminant analysis will be evaluated based on updated information regarding the quantity and physical characteristics of the dredged material.

The material mobilized as a result of the wing dam notches would mostly be sand and is likely similar to that found in the main channel. Therefore, it is likely that the scour hole sediments have low levels of contaminants. However, some of the scour hole sediments will be tested prior to construction to verify this conclusion. The construction of the wing dam notches is intended as environmental enhancement and is not necessary to maintain navigation. Therefore, this action will not be pursued if it is determined that the scour hole sediments contain high levels of contaminants because the benefits gained by increased bathymetric and flow diversity would be reduced or eliminated by the negative effects of the remobilized contaminants.

Rock riprap for all construction would be obtained from existing local quarries. These areas do not have a history of contamination, and use of this material should not introduce any contaminants into the aquatic ecosystem.

Table 3. Main Channel Sediment Quality.

Parameter	**Units**	**River Mile 807.3**	**River Mile 807.8**	**River Mile 807.8**
Collection Date	year	1989	1978	1978
Total Organic Carbon	%	0.17	NA	NA
Moisture Content	%	NA	NA	NA
Volatile Solids	%	0.7	NA	NA
Sand (>0.200 mm)	%	93	96	98
Silts & Clays (<0.200 mm)	%	0	4	2
Arsenic	ppm	1.4	0	0
Cadmium	ppm	<1.1	<10	<10
Chromium	ppm	7.9	<10	<10
Copper	ppm	4	<10	<10
Cyanide	ppm	NA	NA	NA

Parameter	Units	River Mile 807.3	River Mile 807.8	River Mile 807.8
Lead	ppm	2.3	<10	<10
Manganese	ppm	2600	200	450
Mercury	ppm	<0.02	0	0
Nickel	ppm	9.5	<10	<10
Ammonia	ppm	NA	NA	NA
Zinc	ppm	16.9	10	20
a-BHC	ppb	<0.07	NA	NA
b-BHC	ppb	<0.15	NA	NA
g-BHC	ppb	<0.1	NA	NA
d-BHC	ppb	<0.22	NA	NA
Chlordane	ppb	NA	NA	NA
4,4'-DDD	ppb	<0.27	0	0
4,4'-DDE	ppb	<0.1	0	0
4,4'-DDT	ppb	<0.32	0	0
Dieldrin	ppb	<0.12	0	0
Endrin	ppb	<0.22	0	0
Heptachlor	ppb	<0.07	NA	NA
PCBs Total-1016	ppb	<3	0	0

NA – not available

E. Aquatic Ecosystem and Organism Determination

1. Effects on Plankton

During construction, increases in turbidity and suspended solids near the dredged material placement/fill activities would have a localized suppressing effect on phytoplankton productivity. However, these local effects would be short-term and minor. The plankton populations would recover quickly once construction activities have ceased.

2. Effects on Benthos

The proposed structural modifications would have either a neutral or slightly positive long-term effect on benthos productivity.

The proposed Carter Slough spot dike would cover about 0.10 acres of benthic habitat and organisms. Also, some habitat and organisms would be dredged for access to the site. Benthic organisms would quickly be replaced in the dredged channel and would quickly colonize the new rock substrate provided by the dike. This rock substrate would increase the benthic habitat diversity of the area.

Reduced sedimentation in Mud Hen Lake would prevent increases in turbidity there caused by the erosion and widening of Carter Slough. This would prevent future decreases in aquatic vegetation and its benthic inhabitants.

3. Effects on Nekton

During construction, increases in turbidity and suspended solids near the dredged and fill areas would have a localized suppressing effect on nekton productivity. However, these effects would be local, short-term, and minor. The nekton populations would recover quickly once construction activities have ceased.

4. Effects on Aquatic Food Web

The burial of existing benthos and localized impacts on plankton could cause a temporary, minor impact on the local food web. Benthos should quickly colonize the project features and no long-term adverse impact on the aquatic food web is anticipated. The proposed spot dike would help preserve the productivity of Mud Hen Lake. However, productivity in Carter Slough would decrease with the reduction in flows.

5. Effects on Special Aquatic Sites

The Carter Slough spot dike will affect Mud Hen Lake, which is of outside interest to agencies and the public as waterfowl and fish habitat. The impacts of the project on this lake are positive, since the dike will prevent habitat-altering sedimentation.

6. Threatened and Endangered Species

The proposed project would have no effects on any federally listed threatened or endangered species or their critical habitat. The U.S. Fish and Wildlife Service concurs with this determination (Appendix F). Also, it is likely that no state-listed threatened or endangered species would be affected by the project.

7. Other Wildlife

The fill activities would not result in a significant loss of aquatic or terrestrial habitat. Although some secondary channel habitat would be lost in Carter Slough, the diversity and productivity of Mud Hen Lake would be protected. Also, the general diversity and productivity of the other affected areas would increase.

8. Actions Taken to Minimize Impacts

No special actions are required.

F. Proposed Disposal Site Determinations

1. Mixing Zone Determination

Mechanical dredging for equipment access to Carter Slough would likely result in the re-suspension of some fine material in the water column. This would also be the case for structure

modifications/rehabilitation, but to a lesser degree as the coarse rock substrate would have little fine material associated with it. Once a project is complete, suspended solids would quickly return to background levels.

2. Determination of Compliance with Applicable Water Quality Standards

It is not anticipated that the proposed project would violate Minnesota's or Wisconsin's water quality standards for toxicity.

Rock riprap would be obtained from approved pits and quarries in the project area. This area does not have a history of contamination, which should insure that State water quality standards would not be violated during placement of this material.

3. Potential Effects on Human Use Characteristics

a. Municipal and Private Water Supply

No municipal or private wells would be impacted by the proposed project.

b. Recreational and Commercial Fisheries

The wing dam notching is being done to increase habitat diversity and fish and wildlife values, which is also a benefit of the Carter Slough spot dike. As such, recreational fishing could improve slightly. The project may also result in a slight improvement to the commercial fishery.

c. Water Related Recreation and Aesthetics

The aesthetics of the area would be reduced during construction because of the presence and operation of dredging and other construction equipment. Also, the aesthetics at Carter Slough may be reduced by the presence of the exposed spot dike and by the decrease in flows. Minimum water depths of 4 feet would be maintained over the wing dams that are rehabilitated to avoid potential impacts on recreational boaters.

d. Cultural Resources

A historic farm site (21 DK 58) is known for the downstream bank of Carter Slough. The placement of a rock dike across Carter Slough has little or no potential to adversely affect the site. Effect will be minimized by avoiding any staging activities in the site area, and by minimizing any bank preparation necessary to tie in the rock dike. Material dredged from Carter Slough to provide equipment access would be barged to a long-term upland disposal site approved in the CMMP. Therefore coordination for any impacts on the cultural resources at these sites has been completed.

The rehabilitation of wing dams 804.9L, 805.1L. 805.2L, and 805.25L to constrict flows in the area of the Big River dredge cut will have no effect on any known historic property.

However, the St. Paul District has determined that the channel constriction works (wing dams, closing dams, and shore protection) associated with the 4 ½- and 6-foot channel projects are eligible for the National Register of Historic Places. We are currently working with the Minnesota and Wisconsin State Historic Preservation Offices (SHPOs) to further assess and document the eligibility of these historic resources. When the eligibility of the resources has had a final determination, the District will work with the SHPOs to avoid, minimize and/or mitigate any adverse effects that might occur to the wing dams that are being modified. For the purposes of the present project, with the agreement of the SHPOs, the District has determined that the effect of notching 19 wing dams and restoring 4 wing dams on the overall resources (over 1,000 wing dams above La Crosse, Wisconsin) will not be significant. Most of the individual wing dams will suffer only minor effects or will be benefited by stabilization and restoration.

G. Determination of Cumulative Effects on the Aquatic Ecosystem

The Carter Slough spot dike would prevent flows and sediment from entering Mud Hen Lake during normal river discharges. This would prevent the slough from widening further and would also slow the filling of the lake and its succession to terrestrial habitat. People who prefer to allow natural processes to occur, such as sedimentation and filling of water bodies, may view this action as detrimental. However, others may view this as good because it protects valuable habitat for waterfowl and fish.

Wing dam notching would provide increased bathymetric, substrate, and flow diversity that would benefit fish and benthic organisms. This would provide an overall benefit to the fish and wildlife in the project areas.

H. Determination of Secondary Effects on the Aquatic Ecosystem

No significant secondary effects on the aquatic ecosystem would be expected from the proposed action.

III. FINDING OF COMPLIANCE WITH RESTRICTIONS ON DISCHARGE

1. No significant adaptations of the guidelines were made relative to this evaluation.

2. The proposed fill activity would comply with the Section 404(b)(1) guidelines of the Clean Water Act. The placement of fill is required to provide the desired benefits.

3. There are no practical and feasible alternatives to the placement of fill in the proposed sites that would meet the objectives and goals of this project.

4. The proposed fill activity would comply with State water quality standards. The disposal operation would not violate the Toxic Effluent Standards of Section 307 of the Clean Water Act.

5. The proposed projects would not harm any endangered species or their critical habitat.

6. The proposed fill activities would not result in significant adverse effects on human health and welfare, including municipal and private water supplies, recreation and commercial fishing. The proposed activities would not adversely affect plankton, fish, shellfish, wildlife, and special aquatic sites. The life stages of aquatic life and other wildlife would not be adversely affected. Significant adverse effects on aquatic ecosystem diversity, productivity, and stability and on recreational, aesthetic, and economic values would not occur.

7. To minimize the potential for adverse impacts, a couple of actions would be taken: all material would be dredged and placed mechanically; material dredged for access to the Carter Slough spot dike would be barged to a dredged material placement site approved in the Channel Maintenance Management Plan; and notches have been incorporated into the modifications of wing dams 805.1L and 805.2L. Since the proposed action would result in few adverse effects, no additional measures to minimize impacts would be required.

8. On the basis of this evaluation, I specify that the proposed disposal site complies with the requirements of the guidelines for discharge of fill material.

1 June 01
Date

KENNETH S. KASPRISIN
Colonel, Corps of Engineers
District Engineer

APPENDIX E

Habitat Evaluation Appendix

APPENDIX E
Habitat Evaluation

All structures in pool 3 and upper 4 were assessed for habitat deficiencies and the potential for implementation of restoration/enhancement measures. Through a series of interagency meetings, mussel surveys, and on-site inspections, the list was screened to those structures with the following habitat deficiencies or resource problem:

1. Secondary or tertiary channels that have been occluded with sediments as a result of channel control structures. These areas lack bathymetric diversity, generally containing water depths less than 1 meter. Flow also is seasonally restricted.

2. Secondary and tertiary channels that feed backwater lakes, ponds, and marshes that are providing excessive or insufficient flows and sediment input for the desired habitat conditions.

3. A lack of structural diversity in shallow wing dam fields. The basic assumption in this identified resource problem is that biological diversity is often associated with physical heterogeneity. Therefore, the goal of the notching was to create a complex of depth-velocity-substrate types within wing dam fields where there is a high degree of uniformity in these habitat parameters.

The smallmouth bass habitat suitability model, with modifications to incorporate some of the in-stream flow model curves, was used in the analysis of wing dam notching. The following assumptions were used to evaluate the effects of the wing dam notching:

1. The notch and scour hole would change, but remain over the 50-year project life. Also, under the no action alternative, habitat conditions would remain comparable over the next 50 years.

2. Scour holes in shallow main channel border habitat in pool 5 vary in size from 0.1 ha to 1.1 ha. The size of scour holes resulting from wing dam notching in pool 3 was conservatively estimated to average 0.2 ha (0.5 acre) for the habitat benefits' calculation.

3. Secondary channel improvement/restoration would result in a flowing channel that would produce scour holes and uncover additional coarse substrate in the channel bed.

4. In the main channel border habitat in pool 5 where scour holes exist, the scour holes occupy from 10 to 100% of the area downstream of the wing dam up to the next channel training structure. Each study area was defined as the area halfway up- and downstream to the next wing dam, if one was present.

5. The major variables in the smallmouth bass model that would be modified as a result of wing dam notching are substrate type, percent pool/water depth, percent cover, and current velocity.

6. Existing pool habitat was determined to be those areas that are at least 2 m deep. Also, the suitability curve for V_4 was adjusted to account for this assumption by moving the curve to the right one meter. Consequently, the optimum suitability exists at average pool depths greater than 2 m.

7. The notch will expose some of the rock that has been buried by sand and create pockets of gravel in the scour area, thereby increasing substrate heterogeneity.

8. Re-exposing rock substrate and creation of rock groins or mounds will increase the amount of cover available. The amount of cover created was calculated as the estimated volume of material removed from the notch in cubic meters, divided by 0.5 m. This returns the new area covered by coarse material, if it is placed 0.5 m thick. The initial cover available was estimated as the percent coverage of the exposed wing dam in the study area, plus 5% to account for undetected available cover (snags, etc.).

9. The notch will locally increase current in the notch area and decrease current in the deeper scour area that is created, increasing the diversity of the current velocity pattern.

Table E-1 provides a summary of the habitat analysis for the wing dam notching, with tables E-2 through E-9 providing the specific analysis for each structure.

The fate of the material excavated from the notches would be determined on-site. Enhancement options for use of the excavated material will include:

- rock mounds or bars downstream or upstream of the present structures
- placement as rock groins or vanes for stabilizing adjacent shorelines
- wing extensions perpendicular to the existing structures (upstream or downstream)
- placement elsewhere on the existing structures to increase bathymetric and flow diversity
- other environmental enhancement options agreed to by the on-site team.

Table E-1. Summary of habitat analysis for wing dam notching.

Wingdam	Acres	HSI - No action	HSI - With notch	Habitat unit gain	Average annual costs	Average annual costs per habitat unit
809.5R	8.7	0.57	0.70	1.14	$760	$669
809.4R	6.3	0.49	0.63	0.88	$310	$354
809.3R	3.6	0.51	0.68	0.60	$227	$379
*807.8R, 807.6R, 807.4R, 807.3R	19.4	0.47	0.63	3.15	$791	$251
806.1L	4.1	0.62	0.75	0.53	$303	$568
801.7L	5.6	0.52	0.66	0.82	$220	$269
801.6L	5.4	0.44	0.57	0.70	$124	$178
801.4L	4.3	0.41	0.57	0.71	$448	$631
800.6R	5.9	0.53	0.68	0.90	$206	$230
800.4R	4.1	0.48	0.65	0.67	$144	$216
800.3R	2.6	0.48	0.70	0.58	$179	$308
800.0L	4.4	0.62	0.74	0.53	$124	$235
799.8L	2.0	0.61	0.71	0.21	$124	$580
799.7L	1.5	0.64	0.76	0.18	$124	$680
797.6L	2.2	0.59	0.72	0.29	$275	$957
797.5L	1.4	0.59	0.71	0.18	$303	$1,654

* Wing dams being notched for secondary channel improvement.

Table E-2. Habitat analysis for notching wing dams 809.5R and 809.4R.

HABITAT SUITABILITY IMODEL FOR SMALLMOUTH BASS

		Wing dam notching - wing dam 809.5R				Wing dam notching - wing dam 809.4R			
		No action		With Notch		No action		With Notch	
Varia	Description	# of acres	8.7	Average annual cost	$496	# of acres	6.3	Average annual cost	$310
		DATA	HSI	DATA	HSI	DATA	HSI	DATA	HSI
V1	Substrate Type	Sand/cobble	0.20	Sand/gravel/cobble	0.60	Sand/cobble	0.20	Sand/gravel/cobble	0.60
V2	% Pools	25%	0.40	31%	0.50	11%	0.10	18%	0.20
V4	Pool Depth (meters)	>2	1.00	>2	1.00	>2	1.00	>2	1.00
V5	% cover	9%	0.35	10%	0.40	8%	0.30	9%	0.35
V6	pH	Class A	1.00	Class A	1.00	Class A	1.00	Class A	1.00
V8	Dissolved oxygen	>5	1.00	>5	1.00	>5	1.00	>5	1.00
V9	Turbidity	25-50	0.80	25-50	0.80	25-50	0.80	25-50	0.80
V10	Temperature - adult (C)	20-29	1.00	20-29	1.00	20-29	1.00	20-29	1.00
V11	Temperature - embryo (C)	20-29	0.90	20-29	0.90	20-29	0.90	20-29	0.90
V12	Temperature - fry (C)	20-30+	0.90	20-30+	0.90	20-30+	0.90	20-30+	0.90
V13	Temperature - juvenile (C)	20-30+	0.90	20-30+	0.90	20-30+	0.90	20-30+	0.90
V14	Water level fluctuations	Class A	0.50	Class A-C	0.50	Class A	0.50	Class A-C	0.50
V15	Gradient	N/A	0.80	N/A	0.80	N/A	0.80	N/A	0.80
V16	Ave. Current Vel. (spawning) (Note)	0.5 - 1	0.80	0 - 2	0.80	0.5 - 1	0.80	0 - 2	0.80
V17	Ave. Current (Fry)	0.5 - 1	0.80	0 - 2	0.80	0.5 - 1	0.80	0 - 2	0.80
V18	Ave. Current (Juvenile)	0.5 - 1	0.50	0 - 2	0.80	0.5 - 1	0.50	0 - 2	0.80
V19	Ave. Current Vel. (Adult)	0.5 - 1	0.50	0 - 2	0.80	0.5 - 1	0.50	0 - 2	0.80
	Food (Cf) = (v1*v2*v5)1/3		0.30		0.49		0.18		0.35
	Cover (Cc) = (v1+v2+v4+v5)/4		0.49		0.63		0.40		0.54
	Water Quality (Cwq)		0.93		0.93		0.93		0.93
	Reproduction (Cr)		0.63		0.73		0.62		0.72
	Other (Cot) (v15+v16+v17+v18+v19)/5		0.68		0.80		0.68		0.80
	HSI		0.57		0.70		0.49		0.63
	Average Annual HU increase		N/A		1.14		N/A		0.88
	Average Annual Cost/Habitat Unit				**$437**				**$354**

Note: Model was modified to include current velocity as a variable with the use of the Instream Flow Methods curves contained in smallmouth bass HEP model.

Table E-3. Habitat analysis for notching wing dams 809.3R and 807.8R, 807.6R, 807.4R, 807.3R.

HABITAT SUITABILITY IMODEL FOR SMALLMOUTH BASS

		Wing dam notching - wing dam 809.3R				Secondary Channel improvement Notch - 807.8R, 807.6R, 807.4R, 807.3R			
VariaDescription		No action # of acres 3.6		With Notch Average annual cost $227		No action # of acres 19.4		With Notch Average annual cost $791	
		DATA	HSI	DATA	HSI	DATA	HSI	DATA	HSI
V1	Substrate Type - Incubation	Sand/cobble	0.20	Sand/gravel/cobble	0.60	Sand/cobble	0.20	Sand/gravel/cobble	0.60
V2	% Pools	16%	0.20	29%	0.50	8%	0.10	15%	0.20
V4	Pool Depth (meters)	>2	1.00	>2	1.00	>2	1.00	>2	1.00
V5	% cover	7%	0.25	8%	0.30	5%	0.20	10%	0.35
V6	pH	Class A	1.00	Class A	1.00	Class A	1.00	Class A	1.00
V8	Dissolved oxygen	>5	1.00	>5	1.00	>5	1.00	>5	1.00
V9	Turbidity	25-50	0.80	25-50	0.80	25-50	0.80	25-50	0.80
V10	Temperature - adult (C)	20-29	1.00	20-29	1.00	20-29	1.00	20-29	1.00
V11	Temperature - embryo (C)	20-29	0.90	20-29	0.90	20-29	0.90	20-29	0.90
V12	Temperature - fry (C)	20-30+	0.90	20-30+	0.90	20-30+	0.90	20-30+	0.90
V13	Temperature - juvenile (C)	20-30+	0.90	20-30+	0.90	20-30+	0.90	20-30+	0.90
V14	Water level fluctuations	Class A	0.50	Class A-C	0.50	Class A	0.50	Class A-C	0.50
V15	Gradient	N/A	0.80	N/A	0.80	N/A	0.80	N/A	0.80
V16	Ave. Current Vel. (spawning)(Note	0.5 - 1	0.80	0 - 2	0.80	0.5 - 1	0.80	0 - 2	0.80
V17	Ave. Current (Fry)	0.5 - 1	0.80	0 - 2	0.80	0.5 - 1	0.80	0 - 2	0.80
V18	Ave. Current (Juvenile)	0.5 - 1	0.50	0 - 2	0.80	0.5 - 1	0.50	0 - 2	0.80
V19	Ave. Current Vel. (Adult)	0.5 - 1	0.50	0 - 2	0.80	0.5 - 1	0.50	0 - 2	0.80
	Food (Cf)= ((average of v1 values)*v5*v7)1/3		0.22		0.45		0.16		0.35
	Cover (Cc) = ((average v1 values)+v5+v6+v7)/4		0.41		0.60		0.38		0.54
	Water Quality (Cwq)		0.93		0.93		0.93		0.93
	Reproduction (Cr)		0.61		0.70		0.59		0.72
	Other (Cot)(v15+v16+v17+v18+v19)/5		0.68		0.80		0.68		0.80
	HSI		0.51		0.68		0.47		0.63
	Average Annual HU increase		N/A		0.60		N/A		3.15
	Average Annual Cost/Habitat Unit				**$379**				**$251**

Note: Model was modified to include current velocity as a variable with the use of the Instream Flow Methods curves contained in smallmouth bass HEP model.

Table E-4. Habitat analysis for notching wing dams 806.1L and 801.7L.

HABITAT SUITABILITY IMODEL FOR SMALLMOUTH BASS

		Wing dam notching - wing dam 806.1L				Wing dam notching - wing dam 801.7L			
		No action		With Notch		No action		With Notch	
VariaDescription		# of acres	4.1	Average annual cost	$303	# of acres	5.6	Average annual cost	$220
		DATA	HSI	DATA	HSI	DATA	HSI	DATA	HSI
V1	Substrate Type - Incubation	Sand/cobble	0.20	Sand/gravel/cobble	0.60	Sand/cobble	0.20	Sand/gravel/cobble	0.60
V2	% Pools	82%	0.80	82%	0.80	18%	0.30	26%	0.50
V4	Pool Depth (meters)	>2	1.00	>2	1.00	>2	1.00	>2	1.00
V5	% cover	10%	0.35	12%	0.45	5%	0.20	6%	0.25
V6	pH	Class A	1.00	Class A	1.00	Class A	1.00	Class A	1.00
V8	Dissolved oxygen	>5	1.00	>5	1.00	>5	1.00	>5	1.00
V9	Turbidity	25-50	0.80	25-50	0.80	25-50	0.80	25-50	0.80
V10	Temperature - adult (C)	20-29	1.00	20-29	1.00	20-29	1.00	20-29	1.00
V11	Temperature - embryo (C)	20-29	0.90	20-29	0.90	20-29	0.90	20-29	0.90
V12	Temperature - fry (C)	20-30+	0.90	20-30+	0.90	20-30+	0.90	20-30+	0.90
V13	Temperature - juvenile (C)	20-30+	0.90	20-30+	0.90	20-30+	0.90	20-30+	0.90
V14	Water level fluctuations	Class A	0.50	Class A-C	0.50	Class A	0.50	Class A-C	0.50
V15	Gradient	N/A	0.80	N/A	0.80	N/A	0.80	N/A	0.80
V16	Ave. Current Vel. (spawning) (Note	0.5 - 1	0.80	0 - 2	0.80	0.5 - 1	0.80	0 - 2	0.80
V17	Ave. Current (Fry)	0.5 - 1	0.80	0 - 2	0.80	0.5 - 1	0.80	0 - 2	0.80
V18	Ave. Current (Juvenile)	0.5 - 1	0.50	0 - 2	0.80	0.5 - 1	0.50	0 - 2	0.80
V19	Ave. Current Vel. (Adult)	0.5 - 1	0.50	0 - 2	0.80	0.5 - 1	0.50	0 - 2	0.80
	Food (Cf)= ((average of v1 values)*v5*v7)1/3		0.38		0.60		0.23		0.42
	Cover (Cc) = ((average v1 values)+v5+v6+v7)/4		0.59		0.71		0.43		0.59
	Water Quality (Cwq)		0.93		0.93		0.93		0.93
	Reproduction (Cr)		0.63		0.74		0.59		0.69
	Other (Cot)(v15+v16+v17+v18+v19)/5		0.68		0.80		0.68		0.80
	HSI		0.62		0.75		0.52		0.66
	Average Annual HU increase		N/A		0.53		N/A		0.82
	Average Annual Cost/Habitat Unit				**$568**				**$269**

Note: Model was modified to include current velocity as a variable with the use of the Instream Flow Methods curves contained in smallmouth bass HEP model.

Table E-5. Habitat analysis for notching wing dams 801.6L and 801.4L.

HABITAT SUITABILITY IMODEL FOR SMALLMOUTH BASS

Varia	Description	Wing dam notching - wing dam 801.6L				Wing dam notching - wing dam 801.4L			
		No action # of acres 5.4		With Notch Average annual cost $124		No action # of acres 4.3		With Notch Average annual cost $448	
		DATA	HSI	DATA	HSI	DATA	HSI	DATA	HSI
V1	Substrate Type - Incubation	Sand/cobble	0.20	Sand/gravel/cobble	0.60	Sand/cobble	0.20	Sand/gravel/cobble	0.60
V2	% Pools	2%	0.05	11%	0.10	1%	0.05	11%	0.10
V4	Pool Depth (meters)	>2	1.00	>2	1.00	1.50	0.50	>2	1.00
V5	% cover	5%	0.20	6%	0.25	5%	0.20	7%	0.25
V6	pH	Class A	1.00	Class A	1.00	Class A	1.00	Class A	1.00
V8	Dissolved oxygen	>5	1.00	>5	1.00	>5	1.00	>5	1.00
V9	Turbidity	25-50	0.80	25-50	0.80	25-50	0.80	25-50	0.80
V10	Temperature - adult (C)	20-29	1.00	20-29	1.00	20-29	1.00	20-29	1.00
V11	Temperature - embryo (C)	20-29	0.90	20-29	0.90	20-29	0.90	20-29	0.90
V12	Temperature - fry (C)	20-30+	0.90	20-30+	0.90	20-30+	0.90	20-30+	0.90
V13	Temperature - juvenile (C)	20-30+	0.90	20-30+	0.90	20-30+	0.90	20-30+	0.90
V14	Water level fluctuations	Class A	0.50	Class A-C	0.50	Class A	0.50	Class A-C	0.50
V15	Gradient	N/A	0.80	N/A	0.80	N/A	0.80	N/A	0.80
V16	Ave. Current Vel. (spawning)(Note	0.5 - 1	0.80	0 - 2	0.80	0.5 - 1	0.80	0 - 2	0.80
V17	Ave. Current (Fry)	0.5 - 1	0.80	0 - 2	0.80	0.5 - 1	0.80	0 - 2	0.80
V18	Ave. Current (Juvenile)	0.5 - 1	0.50	0 - 2	0.80	0.5 - 1	0.50	0 - 2	0.80
V19	Ave. Current Vel. (Adult)	0.5 - 1	0.50	0 - 2	0.80	0.5 - 1	0.50	0 - 2	0.80
	Food (Cf)= ((average of v1 values)*v5*v7)1/3		0.13		0.25		0.13		0.25
	Cover (Cc) = ((average v1 values)+v5+v6+v7)/4		0.36		0.49		0.24		0.49
	Water Quality (Cwq)		0.93		0.93		0.93		0.93
	Reproduction (Cr)		0.59		0.69		0.59		0.69
	Other (Cot)(v15+v16+v17+v18+v19)/5		0.68		0.80		0.68		0.80
	HSI		0.44		0.57		0.41		0.57
	Average Annual HU increase		N/A		0.70		N/A		0.71
	Average Annual Cost/Habitat Unit				**$178**				**$631**

Note: Model was modified to include current velocity as a variable with the use of the Instream Flow Methods curves contained in smallmouth bass HEP model.

Table E-6. Habitat analysis for notching wing dams 800.6R and 800.4R.

HABITAT SUITABILITY IMODEL FOR SMALLMOUTH BASS

		Wing dam notching - wing dam 800.6R				Wing dam notching - wing dam 800.4R			
VariaDescription		No action # of acres 5.9		With Notch Average annual cost $206		No action # of acres 4.1		With Notch Average annual cost $144	
		DATA	HSI	DATA	HSI	DATA	HSI	DATA	HSI
V1	Substrate Type - Incubation	Sand/cobble	0.20	Sand/gravel/cobble	0.60	Sand/cobble	0.20	Sand/gravel/cobble	0.60
V2	% Pools	15%	0.20	24%	0.40	12%	0.15	24%	0.40
V4	Pool Depth (meters)	>2	1.00	>2	1.00	>2	1.00	>2	1.00
V5	% cover	10%	0.35	11%	0.40	5%	0.20	6%	0.25
V6	pH	Class A	1.00	Class A	1.00	Class A	1.00	Class A	1.00
V8	Dissolved oxygen	>5	1.00	>5	1.00	>5	1.00	>5	1.00
V9	Turbidity	25-50	0.80	25-50	0.80	25-50	0.80	25-50	0.80
V10	Temperature - adult (C)	20-29	1.00	20-29	1.00	20-29	1.00	20-29	1.00
V11	Temperature - embryo (C)	20-29	0.90	20-29	0.90	20-29	0.90	20-29	0.90
V12	Temperature - fry (C)	20-30+	0.90	20-30+	0.90	20-30+	0.90	20-30+	0.90
V13	Temperature - juvenile (C)	20-30+	0.90	20-30+	0.90	20-30+	0.90	20-30+	0.90
V14	Water level fluctuations	Class A	0.50	Class A-C	0.50	Class A	0.50	Class A-C	0.50
V15	Gradient	N/A	0.80	N/A	0.80	N/A	0.80	N/A	0.80
V16	Ave. Current Vel. (spawning)(Note	0.5 - 1	0.80	0 - 2	0.80	0.5 - 1	0.80	0 - 2	0.80
V17	Ave. Current (Fry)	0.5 - 1	0.80	0 - 2	0.80	0.5 - 1	0.80	0 - 2	0.80
V18	Ave. Current (Juvenile)	0.5 - 1	0.50	0 - 2	0.80	0.5 - 1	0.50	0 - 2	0.80
V19	Ave. Current Vel. (Adult)	0.5 - 1	0.50	0 - 2	0.80	0.5 - 1	0.50	0 - 2	0.80
	Food (Cf)= ((average of v1 values)*v5*v7)1/3		0.24		0.46		0.18		0.39
	Cover (Cc) = ((average v1 values)+v5+v6+v7)/4		0.44		0.60		0.39		0.56
	Water Quality (Cwq)		0.93		0.93		0.93		0.93
	Reproduction (Cr)		0.63		0.73		0.59		0.69
	Other (Cot)(v15+v16+v17+v18+v19)/5		0.68		0.80		0.68		0.80
	HSI		0.53		0.68		0.48		0.65
	Average Annual HU increase		N/A		0.90		N/A		0.67
	Average Annual Cost/Habitat Unit				**$230**				**$216**

Note: Model was modified to include current velocity as a variable with the use of the Instream Flow Methods curves contained in smallmouth bass HEP model.

Table E-7. Habitat analysis for notching wing dams 800.3R and 800.0L.

HABITAT SUITABILITY IMODEL FOR SMALLMOUTH BASS

		Wing dam notching - wing dam 800.3R				Wing dam notching - wing dam 800.0L			
		No action		With Notch		No action		With Notch	
VariaDescription		# of acres 2.6		Average annual cost	$179	# of acres 4.4		Average annual cost	$124
		DATA	HSI	DATA	HSI	DATA	HSI	DATA	HSI
V1	Substrate Type - Incubation	Sand/cobble	0.20	Sand/gravel/cobble	0.60	Sand/cobble	0.20	Sand/gravel/cobble	0.60
V2	% Pools	10%	0.05	29%	0.50	87%	0.80	87%	0.80
V4	Pool Depth (meters)	>2	1.00	>2	1.00	>2	1.00	>2	1.00
V5	% cover	9%	0.35	10%	0.40	9%	0.35	10%	0.40
V6	pH	Class A	1.00	Class A	1.00	Class A	1.00	Class A	1.00
V8	Dissolved oxygen	>5	1.00	>5	1.00	>5	1.00	>5	1.00
V9	Turbidity	25-50	0.80	25-50	0.80	25-50	0.80	25-50	0.80
V10	Temperature - adult (C)	20-29	1.00	20-29	1.00	20-29	1.00	20-29	1.00
V11	Temperature - embryo (C)	20-29	0.90	20-29	0.90	20-29	0.90	20-29	0.90
V12	Temperature - fry (C)	20-30+	0.90	20-30+	0.90	20-30+	0.90	20-30+	0.90
V13	Temperature - juvenile (C)	20-30+	0.90	20-30+	0.90	20-30+	0.90	20-30+	0.90
V14	Water level fluctuations	Class A	0.50	Class A-C	0.50	Class A	0.50	Class A-C	0.50
V15	Gradient	N/A	0.80	N/A	0.80	N/A	0.80	N/A	0.80
V16	Ave. Current Vel. (spawning)(Note	0.5 - 1	0.80	0 - 2	0.80	0.5 - 1	0.80	0 - 2	0.80
V17	Ave. Current (Fry)	0.5 - 1	0.80	0 - 2	0.80	0.5 - 1	0.80	0 - 2	0.80
V18	Ave. Current (Juvenile)	0.5 - 1	0.50	0 - 2	0.80	0.5 - 1	0.50	0 - 2	0.80
V19	Ave. Current Vel. (Adult)	0.5 - 1	0.50	0 - 2	0.80	0.5 - 1	0.50	0 - 2	0.80
	Food (Cf) = ((average of v1 values)*v5*v7)1/3		0.15		0.49		0.38		0.58
	Cover (Cc) = ((average v1 values)+v5+v6+v7)/4		0.40		0.63		0.59		0.70
	Water Quality (Cwq)		0.93		0.93		0.93		0.93
	Reproduction (Cr)		0.63		0.73		0.63		0.73
	Other (Cot)(v15+v16+v17+v18+v19)/5		0.68		0.80		0.68		0.80
	HSI		0.48		0.70		0.62		0.74
	Average Annual HU increase		N/A		0.58		N/A		0.53
	Average Annual Cost/Habitat Unit				**$308**				**$235**

Note: Model was modified to include current velocity as a variable with the use of the Instream Flow Methods curves contained in smallmouth bass HEP model.

Table E-8. Habitat analysis for notching wing dams 799.8L and 799.7L.

HABITAT SUITABILITY IMODEL FOR SMALLMOUTH BASS

		Wing dam notching - wing dam 799.8L				Wing dam notching - wing dam 799.7L			
		No action		With Notch		No action		With Notch	
Varia	Description	# of acres 2.0		Average annual cost	$124	# of acres 1.5		Average annual cost	$124
		DATA	HSI	DATA	HSI	DATA	HSI	DATA	HSI
V1	Substrate Type - Incubation	Sand/cobble	0.20	Sand/gravel/cobble	0.60	Sand/cobble	0.20	Sand/gravel/cobble	0.60
V2	% Pools	94%	0.80	94%	0.80	71%	1.00	75%	1.00
V4	Pool Depth (meters)	>2	1.00	>2	1.00	>2	1.00	>2	1.00
V5	% cover	8%	0.30	8%	0.30	9%	0.35	10%	0.40
V6	pH	Class A	1.00	Class A	1.00	Class A	1.00	Class A	1.00
V8	Dissolved oxygen	>5	1.00	>5	1.00	>5	1.00	>5	1.00
V9	Turbidity	25-50	0.80	25-50	0.80	25-50	0.80	25-50	0.80
V10	Temperature - adult (C)	20-29	1.00	20-29	1.00	20-29	1.00	20-29	1.00
V11	Temperature - embryo (C)	20-29	0.90	20-29	0.90	20-29	0.90	20-29	0.90
V12	Temperature - fry (C)	20-30+	0.90	20-30+	0.90	20-30+	0.90	20-30+	0.90
V13	Temperature - juvenile (C)	20-30+	0.90	20-30+	0.90	20-30+	0.90	20-30+	0.90
V14	Water level fluctuations	Class A	0.50	Class A-C	0.50	Class A	0.50	Class A-C	0.50
V15	Gradient	N/A	0.80	N/A	0.80	N/A	0.80	N/A	0.80
V16	Ave. Current Vel. (spawning)(Note	0.5 - 1	0.80	0 - 2	0.80	0.5 - 1	0.80	0 - 2	0.80
V17	Ave. Current (Fry)	0.5 - 1	0.80	0 - 2	0.80	0.5 - 1	0.80	0 - 2	0.80
V18	Ave. Current (Juvenile)	0.5 - 1	0.50	0 - 2	0.80	0.5 - 1	0.50	0 - 2	0.80
V19	Ave. Current Vel. (Adult)	0.5 - 1	0.50	0 - 2	0.80	0.5 - 1	0.50	0 - 2	0.80
	Food (Cf)= ((average of v1 values)*v5*v7)1/3		0.36		0.52		0.41		0.62
	Cover (Cc) = ((average v1 values)+v5+v6+v7)/4		0.58		0.68		0.64		0.75
	Water Quality (Cwq)		0.93		0.93		0.93		0.93
	Reproduction (Cr)		0.62		0.70		0.63		0.73
	Other (Cot)(v15+v16+v17+v18+v19)/5		0.68		0.80		0.68		0.80
	HSI		0.61		0.71		0.64		0.76
	Average Annual HU increase		N/A		0.21		N/A		0.18
	Average Annual Cost/Habitat Unit				**$580**				**$680**

Note: Model was modified to include current velocity as a variable with the use of the Instream Flow Methods curves contained in smallmouth bass HEP model.

Table E-9. Habitat analysis for notching wing dams 797.6L and 797.5L.

HABITAT SUITABILITY IMODEL FOR SMALLMOUTH BASS

		Wing dam notching - wing dam 797.6L				Wing dam notching - wing dam 797.5L			
		No action # of acres 2.2		With Notch Average annual cost $275		No action # of acres 1.4		With Notch Average annual cost $303	
Varia	Description	DATA	HSI	DATA	HSI	DATA	HSI	DATA	HSI
V1	Substrate Type - Incubation	Sand/cobble	0.20	Sand/gravel/cobble	0.60	Sand/cobble	0.20	Sand/gravel/cobble	0.60
V2	% Pools	45%	0.90	67%	1.00	73%	1.00	75%	1.00
V4	Pool Depth (meters)	>2	1.00	>2	1.00	>2	1.00	>2	1.00
V5	% cover	5%	0.20	6%	0.25	5%	0.20	6%	0.25
V6	pH	Class A	1.00	Class A	1.00	Class A	1.00	Class A	1.00
V8	Dissolved oxygen	>5	1.00	>5	1.00	>5	1.00	>5	1.00
V9	Turbidity	25-50	0.80	25-50	0.80	25-50	0.80	25-50	0.80
V10	Temperature - adult (C)	20-29	1.00	20-29	1.00	20-29	1.00	20-29	1.00
V11	Temperature - embryo (C)	20-29	0.90	20-29	0.90	20-29	0.90	20-29	0.90
V12	Temperature - fry (C)	20-30+	0.90	20-30+	0.90	20-30+	0.90	20-30+	0.90
V13	Temperature - juvenile (C)	20-30+	0.90	20-30+	0.90	20-30+	0.90	20-30+	0.90
V14	Water level fluctuations	Class A	0.50	Class A-C	0.50	Class A	0.50	Class A-C	0.50
V15	Gradient	N/A	0.80	N/A	0.80	N/A	0.80	N/A	0.80
V16	Ave. Current Vel. (spawning)(Note	0.5 - 1	0.80	0 - 2	0.80	0.5 - 1	0.80	0 - 2	0.80
V17	Ave. Current (Fry)	0.5 - 1	0.80	0 - 2	0.80	0.5 - 1	0.80	0 - 2	0.80
V18	Ave. Current (Juvenile)	0.5 - 1	0.50	0 - 2	0.80	0.5 - 1	0.50	0 - 2	0.80
V19	Ave. Current Vel. (Adult)	0.5 - 1	0.50	0 - 2	0.80	0.5 - 1	0.50	0 - 2	0.80
	Food (Cf)= ((average of v1 values)*v5*v7)1/3		0.33		0.53		0.34		0.53
	Cover (Cc) = ((average v1 values)+v5+v6+v7)/4		0.58		0.71		0.60		0.71
	Water Quality (Cwq)		0.93		0.93		0.93		0.93
	Reproduction (Cr)		0.59		0.69		0.59		0.69
	Other (Cot)(v15+v16+v17+v18+v19)/5		0.68		0.80		0.68		0.80
	HSI		0.59		0.72		0.59		0.72
	Average Annual HU increase		N/A		0.29		N/A		0.18
	Average Annual Cost/Habitat Unit				**$957**				**$1,654**

Note: Model was modified to include current velocity as a variable with the use of the Instream Flow Methods curves contained in smallmouth bass HEP model.

APPENDIX F

Correspondence/Coordination

The draft Definite Project Report/Environmental Assessment was sent to the following.

Congressional
Sen. Mark Dayton (Twin Cities Office)
Sen. Russell Feingold (Middleton Office)
Sen. Herbert Kohl (Madison Office)
Sen. Paul Wellstone (St. Paul Office)
Rep. Ron Kind (La Crosse Office)
Rep. Gil Gutknecht (Rochester Office)

Federal
Environmental Protection Agency (Chicago)
Department of Transportation (Homewood, Des Plains)
U.S. Coast Guard (St. Louis, St. Paul, La Crescent)
U.S. Geological Survey (Madison, Mounds View)
National Park Service (Omaha, St. Paul)
National Resource Conservation Service (Madison, St. Paul)
Advisory Council on Historic Preservation (Wash DC)
U.S. Fish and Wildlife Service - (Twin Cities - Hartwig, Peterson, Wege)

State of Wisconsin

Department of Natural Resources (Madison - Bazzell ; La Crosse - Moe, G. Benjamin; Alma - Brecka)
Department of Transportation (Madison)
State Historic Preservation Office

State of Minnesota

Department of Natural Resources (St. Paul - Garber, Balcom, Johnson, Enblom; Lake City - Johnson, Schlagenhaft, Dieterman; Shakopee - Regenshied)
Minnesota Pollution Control Agency (St. Paul - Willet, Mader)
Department of Transportation
State Historic Preservation Office
Water and Soil Resource Board

State of Iowa

Department of Natural Resources (Des Moines - Szcodronski)

Local

Praire Island Indian Community (Westra, Wills)
City of Red Wing, MN
City of Hastings, MN
Pierce County Commissioners
Dakota County Board of Commissioners
Red Wing Port Authority
City of Prescott, WI
Town of Trenton
Washington County Board of Commissioners
Goodhue County Board of Commissioners

Other Interests

Minnesota-Wisconsin Boundary Area Commission (Hudson)
Upper Mississippi River Conservation Committee (Rock Island)
Sierra Club (Madison, Minneapolis)
Izaak Walton League (Edina)
Upper Mississippi River Basin Association (St. Paul)
Mississippi River Regional Planning Commission (La Crosse)
American Rivers
Upper River Services, Inc.
Mississippi River Revival
MARC 2000
Upper Mississippi Waterways Association
Red Wing Wildlife Protection League
Diamond Bluff Associates (Larson)

Libraries/Media

Hastings Public Library
Wabasha Public Library
Hastings Star Gazette
Prescott Journal
River Falls Journal
Prescott Public Library
Red Wing Public Library
Pierce County Herald
Republican Eagle (Red Wing)

CEMVP-PE-M 21 August 1998

MEMORANDUM FOR RECORD

SUBJECT: Pool 3/Upper 4 Channel Management Study

1. An initial coordination meeting for the subject study was held at the Fountain City Service Base on 20 July 1998. Meeting attendees were:

Teri Alberico	COE	Paul Machajewski	COE
Dennis Anderson	COE	Judy Mader	MPCA
Brian Brecka	WDNR	Gary Palesh	COE
Jon Hendrickson	COE	Al Stevens	MDNR
Scot Johnson	MDNR	Gary Wege	USFWS
Dan Krumholz	COE		

The primary purpose of the meeting was to discuss channel maintenance, navigation, environmental, recreation, and other conditions in the study area; discuss study area definition; and identify data needs. Meeting discussions are synopsized in this memorandum by subject matter.

2. Channel Maintenance

a. There are eight historic dredge cuts in pool 3 and five historic dredge cuts in upper pool four. Some of the dredge cuts are not active and have not been dredged since the early 1970's. Four dredge cuts are currently considered problem areas. They are the lower approach to L/D 2, Coulter's Island, and Diamond Bluff dredge cuts in pool 3, and the Cannon River dredge cut in upper pool four.

b. Most dredged material placement in the recent past has been at the Hastings site near L/D 2; at Corps Island, a temporary site near Diamond Bluff, Wisconsin; and at Covill Park below Red Wing, Minnesota.

c. The District is currently unloading Corps Island and having the dredged material placed in a gravel pit north of Diamond Bluff. An estimated 300,000 to 400,000 cubic yards will be removed from the site. The District is working on obtaining easements for use of the gravel pit for future placement which would allow direct placement from the Coulter's Island dredge cut.

d. The District has reached agreement for use of the Red Wing commercial harbor site where the material would be placed in a beneficial use stockpile.

e. Shoaling problems at the lower approach to L/D 2 may be caused by hydropower operations at this dam.

f. Increased flow from the main channel into North and Sturgeon Lakes may be contributing to increased dredging frequencies at the Coulter's Island and Diamond Bluff dredge cuts.

g. Removal of a dam at Welch, Minnesota, on the Cannon River in 1993 may have contributed to increased dredging frequencies at the Cannon River dredge cut. If there was an effect, it probably was minimal due to the small pool behind the dam, and the fine sediments commonly found in small impoundments would likely not settle out in main channel shoals.

h. Shoaling at the head of Lake Pepin would normally require dredging nearly every year. However, tow boats may be keeping the channel open in this area by resuspending fine sediments with their passage.

I. Increasing outflows to the Wisconsin Channel were corrected in the early 1990's by restoring the closing dam located in the upper reaches of the channel. The restored closing dam contains a marked notch for recreational boat passage.

4. Navigation

a. The shoaling at the lower approach to L/D 2 can adversely affect tow boats entering and leaving the lock.

b. The deltas formed at the mouths of small Wisconsin tributaries in pool 3 create bends in the navigation channel that can be difficult to negotiate for tows.

c. Increased flow from the main channel into North and Sturgeon Lakes is resulting in some outdraft effects on tow boats.

d. The increased rate of shoaling that has occurred in the Coulter's Island/Diamond Bluff area over the past decade has increased the rate of groundings in this area.

e. There is a difficult bend for tow boats above the Red Wing bridge. A hazardous situation may have developed with the development of a marina on the left descending bank above the bridge. In addition, the right descending bank at Levee Park further constricts this reach with a docking facility that sticks out past the levee wall.

5. Environment

a. There is a poor understanding of the hydrologic and water quality relationships between the Mississippi River and the Vermillion River system. Pool 3 is actually perched above the adjacent Vermillion River.

b. A channel from the Vermillion River connects with the Mississippi River at river mile 813.2. Flows in this channel go in either direction depending on the relative stages of the two rivers.

c. There has been some consideration of placing a structure in the Vermillion River to route more flows through the above-mentioned channel to keep high phosphorus discharges from an upstream sewage treatment plant out of the Vermillion River bottoms area.

d. A continuous channel has formed from Carter Slough to the Vermillion River, via Mud Hen Lake and Round Lake. These lakes support excellent emergent aquatic vegetation, which may be affected by this changed hydrologic condition.

e. There are eagle nests located in a number of locations in pool 3, and possibly a heron rookery.

f. It is unknown what effect fish passage through lock and dam 2 contributes to supporting the trophy walleye fishery in pool 2.

g. It is unknown what effects pools 2 and 3 may have on thriving downstream (Lake Pepin) zebra mussel colonies.

h. North Lake is generally turbid with little aquatic vegetation. Side channels entering the lake from the main channel appear to be enlarging. The only good habitat is that being created by deltas forming where main channel flows enter the lake. The lake does support a fishery for largemouth bass, walleye, and northern pike primarily centered around a deeper area of the lake along the west shoreline. At one time restoration of habitat in North Lake was a project under consideration under the UMRS-EMP. The project was dropped from consideration at the request of the Minnesota DNR because of cost sharing requirements.

I. Goose Lake still has potential for restoration, re: the deferred habitat project under the UMRS-EMP. This lake is popular for winter spearing of northern pike.

j. Sturgeon Lake is similar in habitat quality to North Lake.

k. Nelson Lake at one time supported wild rice. The lake may now be impounded to some degree by a road. This impounding has degraded conditions for the growth of wild rice.

l. It has been documented that walleyes from Lake Pepin move up into the Vermillion River system. The Vermillion River supports an excellent fishery.

m. The channel behind Diamond Island (river mile 795) is filling in.

n. The main channel adjacent to Diamond Island is relatively deep and is a catfish overwintering area.

o. Most of the Cannon River bottomlands area downstream of the railroad tracks is owned by the Red Wing Wildlife Protective League and managed for wildlife habitat.

p. The Wisconsin Channel at one time supported good mussel beds. Their current condition is unknown.

r. Goose Lake in upper pool 4 has deep water, is spring fed, and supports a good winter fishery for crappies, bluegills, and northern pike. It also receives seasonal use by walleye.

s. Mud and Dead Slough Lakes in upper pool 4 are shallow and turbid. They receive some seasonal use by fish. There is a submerged closure structure in Dead Slough Lake, origin unknown.

t. From Covill Park to Wacouta is an area designated as a winter bald eagle roosting area.

u. The Pierce County Islands area located above Bay City was at one time considered for habitat improvement under the Section 1135 program. It still may be considered in the future under the UMRS-EMP or other habitat restoration authorities.

v. The Bay City Islands project (island construction in Lake Pepin near Bay City) was a project identified for consideration under the UMRS-EMP. The project never received sufficient priority status to be studied.

6. Recreation

a. A draft recreational beach plan has been completed for pool 3 and upper pool 4.

b. Beaching is the study area is not a popular activity, primarily due to the lack of suitable beach sites.

c. Recreational boating has been shown to be contributing to shoreline erosion in the Red Wing area.

7. Other

a. Large portions of the floodplain in the study area are in private ownership, in contrast to the pools below Lake Pepin where most of the floodplain is in public ownership.

b. The Prairie Island Indian Reservation is located in pool 3.

c. The Prairie Island nuclear generating station is located in pool 3. This plant discharges heated water to the river which can be detected all the way to Lake Pepin. The plant has a license to withdraw a maximum 1,400 cfs from the river.

8. Study Area Definition

a. The upstream boundary of the study area is L/D 2 and the downstream boundary is Lake Pepin.

b. The lateral boundaries are generally the railroad tracks paralleling the river, though that determination is arbitrary and can be modified as necessary.

c. The lower St. Croix River is part of pool 3. It was suggested that consideration be given to including the lower St. Croix River in this study.

9. <u>Data Needs</u>

a. The Minnesota LTRM station has collected bathymetry and other data for upper pool 4 that will be of value to this study.

b. The District has been and will be collecting flow data to address channel maintenance problems and assist in defining some of the hydrologic relationships between the Mississippi and Vermillion Rivers.

c. The Minnesota DNR has bathymetry data for North and Sturgeon Lakes which they will be providing. The Minnesota DNR also has data concerning the location of eagle nests, eagle roosting sites, and heron rookeries.

d. The District has entered Mississippi River channel control structures in a GIS data base. Maps of the structures in pool 3 and upper pool 4 will be generated in the near future.

10. Activity on this study for the next few months will focus on data and information gathering. The current schedule is to complete the study in the 2nd quarter of FY 2001.

Gary Palesh
Technical Manager

DEPARTMENT OF THE ARMY
ST. PAUL DISTRICT, CORPS OF ENGINEERS
ARMY CORPS OF ENGINEERS CENTRE
190 FIFTH STREET EAST
ST. PAUL, MN 55101-1638

REPLY TO
ATTENTION OF

NOV 30 1999

Project Management Branch
Planning, Programs, and Project Management Division

SUBJECT: Pool 3/Upper Pool 4 Channel Management Study

Dear River Resources Forum:

Enclosed for your review is the draft Problem Appraisal Report for Pool 3/Upper Pool 4 Channel Management Study. Please review this document and provide any comments you may have by January 21, 2000.

If you have any questions please contact me at 651-290-5282 or at gary.d.palesh@mvp02.usace.army.mil.

Sincerely,

Gary Palesh
Project Manager

Enclosure

DEPARTMENT OF THE ARMY
ST. PAUL DISTRICT, CORPS OF ENGINEERS
ARMY CORPS OF ENGINEERS CENTRE
190 FIFTH STREET EAST
ST. PAUL, MN 55101-1638

December 6, 1999

REPLY TO
ATTENTION OF

Project Management Branch
Planning, Programs and Project Management Division

Ms. Heather Westra
Environmental Coordinator
Prairie Island Dakota Community
1158 Island Boulevard
Welch, Minnesota 55089

Dear Ms. Westra:

Enclosed for your information and review is a draft Problem Appraisal Report (PAR) for our Pool 3/Upper Pool 4 Channel Management Study.

The purpose of the PAR is to:

a. identify the channel maintenance, navigation, environmental, and recreational problems and opportunities in the study area, and

b. identify where future study efforts will occur to address these problems and opportunities.

This study is part of our program for maintenance of the 9-foot navigation channel on the Upper Mississippi River. Our primary focus is on identifying where our maintenance of the navigation channel and/or modification of our channel control structures (wing dams) can address the problems and opportunities identified for the study reach.

We request that you provide any comments you may have on the draft PAR by January 21, 2000. Following receipt of comments, we will finalize the PAR and then move forward to the next study phase, a more detailed evaluation of the measures identified for further study in the PAR. The culmination of the study process will be a report recommending actions for implementation. Our current schedule calls for completing a draft report by September 2000.

We will schedule our next coordination meeting with the resource management agencies involved in this study to take place in January 2000. You are invited to attend this meeting, and I will inform you of the time and location when arrangements are made. If you have any questions, please contact me at 651-290-5282 or at gary.d.palesh@mvp02.usace.army.mil.

Sincerely,

Enclosure

Gary Palesh
Project Manager

CEMVP-CO-MR 16 December 1999

MEMORANDUM FOR RECORD

SUBJECT: Navigation Industry Meeting

1. On 14 December 1999, Paul Machajewski and myself met with representatives of the River Industy Action Committee (RIAC) at the offices of the USCG in the Federal Building at St. Louis. Representatives of MVR, MVS and the USCG also attended. An attendance list is attached.

2. Our purpose for meeting with the industry was to coordinate the Pool 3/Upper Pool 4 Channel Management study that we have initiated. Several of the study objectives are to reduce or control dredging requirements and improve navigation safety. Input is needed from the towing industry to identify navigation problems so that those areas can be addressed in the study. We distributed copies of our November, 1999 draft problem appraisal report and reviewed the purpose and scope of the study. We also distributed copies of our continuous survey maps. One area of concern that they identified is at the upper end of Lake Pepin. Comments from the industry were requested by the end of January.

3. There was considerable discussion on the upcoming Pool 8 drawdown project. I indicated that the project is approved including section 1135 funding for recreational dredging. We are treating it as a demonstration project and have established some contingencies which include assuring that navigation is not adversely impacted. In preparation, we did some advance maintenance dredging in the Brownsville area this fall. They are concerned about what we would consider unacceptable channel conditions in determining whether to abort the drawdown. I indicated that we are confident that we can maintain acceptable channel conditions during the drawdown period and will devote the resources to do so (i.e. survey launch, dredging equipment). We will evaluate the channel before the drawdown begins to assure that manageable conditions exist. Results of early surveys will be a factor in deciding to proceed with the drawdown. The greatest area of concern is in the Brownsville area. The reach downstream of the La Crosse RR bridge is a navigation concern but will experience little change in water surface elevation The industry wants to be informed when the drawdown begins. I said that we would issue a navigation notice and that the USCG would probably be releasing an advisory. The USCG representative said that they will plan a buoy run right before the drawdown begins.

4. Other topics discussed at the meeting:

   a. Navigation charts - MVR had draft samples of the new charts available for review. Jim Aidala is coordinating this effort and his memo is attached.

b. Lock 3 Outdraft - I reported that the study and proposed design for a guidewall extension is complete but the project is awaiting O&M funding. This remains a major safety concern for the industry.

c. La Crosse RR Bridge - Several of the pilots expressed concern about a sheetpile cell just downstream of the bridge. It is a navigation hazard when flows are high. I indicated that we would check into it.

d. MVR Channel Review - MVR primary purpose at the meeting was to discuss general channel conditions with the pilots. They did a mile by mile review of the river in their District to solicit pilot comments on channel conditions. RIAC indicated that they would also like to do the same with us at some time. We are receptive to that idea.

e. Navigation Conference - The annual navigation conference is scheduled for 21-22 March 2000 at the Mariott in St. Louis. Tim Robinson, RIAC Chairman and Mike Kruckeberg, MVS are receiving suggestions for agenda topics.

DAN KRUMHOLZ
Chief, Waterways Section

Attendance List

Name	Organization	Phone
Tom Gambucci	USACE Rock Island	309-794-5848
Don Hubbard	Capt. ARTCO	501-452-1533
Weiss DeVos	CoE Rock Island	309-794-5240
Kenny Brenner	CoE Rock Island	309-794-5842
Terry Inman	Capt. ACBL	618-254-1706
Tim Robinson	ACBL/RIAC	314-845-3232
Tommy Seals	BWT/RIAC	314-992-0194
Dan Krumholz	CoE St. Paul	608-687-3011
Paul Machajewski	CoE St. Paul	608-687-3011
Raymond Hopkins	ARTCO/RIZC	314-481-8828
Steve Cirinna	USCG Group Upper	319-524-7511
Dan Schroder	USCG MSO St. Louis	314-539-3091 x-218
Wayne Williams	Alter Barge Line/RIAC	618-258-0871
James Aidala	USACE Rock Island	309-794-5455
Chuck Camiuo	USACE St. Louis	314-331-8002
Harold Dodd	Memco Barge Line	573-334-8212
Ronald Callegan	Memco Barge Line	225-344-9563
Wally Feld	CoE St. Louis	314-331-8557
Lance Engle	CoE St. Louis	314-263-4708
Bob Goodwin	MARAD	314-539-6783

WISCONSIN
DEPT. OF NATURAL RESOURCES

State of Wisconsin \ DEPARTMENT OF NATURAL RESOURCES

Tommy G. Thompson, Governor
George E. Meyer, Secretary
Scott A. Humrickhouse, Regional Director

3550 Mormon Coulee Rd
La Crosse, Wisconsin 54601
Telephone 608-785-9000
FAX 608-785-9990

January 6, 2000

Mr. Gary Palesh
U.S. Army Corps of Engineers – St. Paul District
190 Fifth Street E.
St. Paul, MN 55101

RE: Pool 3/Upper Pool 4 Channel Management Study

Dear Mr. Palesh:

Wisconsin Department of Natural Resources staff from Lower St. Croix Mississippi Team have reviewed the Draft Problem Appraisal Report Pool 3 – Upper 4 Channel Management Study and would like to provide the following comments.

GENERAL COMMENTS

1 Most of the information contained in this report mimics the standard format for a Channel Management Plan (CMP). The goals as stated for this CMP are appropriate and acceptable.

2 Two objectives should be added to list in section 6.4. Either section 6.4.1 or 6.4.2 should include an objective, Install Mooring Cells at Lock Waiting areas for Locks and Dams 2 and 3. Under section 6.4.2 an additional objective should be added after 6.4.2.6 that states, Restore habitat quality within Pierce County Wildlife Area. Objective 6.4.2.7 should then become objective 6.4.2.8.

3 During the CMP process for Pool 5 a public meeting was held that brought out local river people and the these people provided additional insight into habitat restoration. Similar meetings in Red Wing and possibly Diamond Bluff or Prescott may produce similar results. We recommend a public meeting be held in the near future.

4 Due to the generic nature of this document there are not any specific recommendations for habitat improve. We would like to recommend that the Corps investigate the notching of the wingdams on the Wisconsin side between river mile 810.0 and 810.8. We believe based on the bathymetry of the area this series of wingdams could be notched to provide a secondary channel just off of the main channel. The first steps in the investigation of this area would be to determine the impact this would have on the navigation channel and what types of mussel resources are in this area.

SPECIFIC COMMENTS

5 On pages 1-5 and 6-2 the Lock and Dam 3 outdraft problem is described. The title should be changed to read Lock and Dam 3 Outdraft Condition instead of Outdraft Dike.

6 In section 2.3, Water Quality, the first sentence should read "In Pools 3 and **Upper** 4, water quality is affected by the **Minnesota River**, the large upstream urban areas … the river's bedload."

7 The second paragraph, last sentence should be changed to say, " The high suspended load from the Minnesota River **greatly** influences suspended solids levels in this reach.

The sixth paragraph should read, "the Minnesota River and **municipal wastewater discharges from the Twin Cities area are major sources** of nutrients to the upper pools. The third sentence is in error. John
8 Sullivan suggests that you mean phosphorus not nitrogen. The primary form of nitrogen is dissolved nitrogen and that does not settle. John also points out that there has been a significant reduction in ammonia N due to point source abatement over the last 20 years.

9 On page 4-5, the last sentence in the first paragraph should say Pools 3 and Upper **4**. Presently it says pools 3 and Upper 3.

10 For section 4.4.1.2, John Sullivan suggests you get information from the recent study done by Dan Engstrom Science Center that found substantially greater sedimentation occurring in upper Lake Pepin.

11 Section 4.4.2, the last two sentences should be changed. Data collected in these area shows PCB levels in fish and sediment are decreasing.

Figure 1, page 5-4, should have an asterisk by the years 1996-98 with an explanation of the higher dredging quantities during those years. The quantities of material dredged in 1998 were higher than
12 normal because the contractor cleaned out the channel during the process of unloading Corps Island. I believe 120,000 cubic yards was taken out of the channel in 1998 and even though minimal depth dredging was the normal during the last several years, this amount was in excess of what would typically be dredged to maintain the nine-foot channel.

13 The second sentence on Page 6-2 has misspelled the word **complete**, it is currently spelled **compete**.

Thank you, for the opportunity to comment on this document.

Sincerely,

Gretchen L. Benjamin
Mississippi River Planner

C Gary Wege - USFWS, Bloomington, MN
Scot Johnson - MDNR, Lake City, MN
Brian Brecka - WDNR, Alma, WI
Dan Krumholz – USACE, Fountain City, WI
Judy Mader – MPCA, St. Paul, MN

Responses to Comments Provided by the Wisconsin DNR dtd January 6, 2000

1. No response necessary.

2. Partially concur. An objective has been added concerning lock waiting areas (new section 6.4.1.3). With regards to the Pierce County Islands, we indicate in section 6.1.5 that the Pierce County Island project will not be considered under this study and the reasons why. Therefore, a study objective is not necessary for this particular site.

3. A public meeting(s) will be held in the near future.

4. This area will be considered for wing dam notching.

5. The suggested change has been made.

6. The suggested changes have been made.

7. The suggested change has been made.

8. The suggested changes have been made.

9. This error has been corrected.

10. The discussion in section 4.4.1.2 focuses on backwater sedimentation, while the situation at the head of Lake Pepin is somewhat unique and more akin to sedimentation in delta areas. We will review the referenced document and add applicable information to this section in the draft Definite Project Report.

11. It has been noted in the referenced section that PCBs are declining. However, we believe contaminant levels in general still remain high in this river reach.

12. The referenced figure has been changed to cover the period 1996-99. Information has been added to the text concerning the 1998 dredging.

13. This error has been corrected.

CEMVP-PM-A 20 January 2000

MEMORANDUM FOR RECORD

SUBJECT: Pool 3/Upper Pool 4 Channel Management Study

1. A coordination meeting for the subject study was held on 19 January 2000 in the Lake City offices of the Minnesota Department of Natural Resources. Meeting attendees were:

Dennis Anderson	COE (PM-E)	Scot Johnson	MDNR
Gretchen Benjamin	WDNR	Judy Mader	MPCA
Brian Brecka	WDNR	Dan Oles	COE (CO-MR)
Mike Davis	MDNR	Gary Palesh	COE (PM-A)
Dan Dieterman	MDNR	Gary Wege	USFWS
Jon Hendrickson	COE (ED-H)	Craig Wills	Prairie Island Indian Community

2. The purpose of the meeting was primarily to discuss in further detail where study efforts will be focused.

a. Lock and Dam 2 Cross Current - At Lock and Dam 2, currents from flow passing through the dam enter the navigation channel below the lower guide wall in a somewhat perpendicular manner. This lateral current entering the channel can affect the maneuverability of upbound barge tows entering the lock because the tows at this point are slowing down to enter the lock. Jon Hendrickson gave a brief presentation and indicated that our study will focus on extending the lower guide wall to transfer the lateral current farther downstream where tows will be operating under power and should be better able to cope with it. Resource management agencies would like to see any structural solution such as a guidewall extension kept to the minimum possible.

b. Lock and Dam 2 Flats - Below Lock and Dam 2, on the left descending bank between river mile 814.3 and 814.8 is a shallow flat with water depths generally less than 2 feet. The fish habitat value of this area appears limited due to shallow depths and lack of aquatic vegetation. The construction of an island or other structure in this area may stimulate the formation of a secondary channel through this flat, improving habitat diversity and quality.

Meeting attendees were generally unfamiliar with the habitat values of this area or the physical conditions (depth, substrate type). The resource management agencies were not adverse at this time to further investigation into habitat restoration opportunities at this site, including the use of dredged material. All parties agreed that more information concerning this site needs to be collected.

c. Carter Slough - A continuous connection has been formed from Carter Slough (river mile 807.3) to the Vermillion River via Mud Hen Lake and Round Lake. These lakes support a high quality emergent aquatic vegetation fringe. The Minnesota Department of Natural Resources (MDNR) has expressed concern that this changed condition may eventually affect aquatic vegetation in these lakes, especially if this connection becomes larger and more flow passes through these lakes. The preliminary indication from the MDNR wildlife managers for the area is that they would like flows to these lakes via Carter Slough cut off during "normal" river stages.

Jon Hendrickson stated that what we may be able to do at this site is to insure that the existing spot dike structures are functioning and have not been bypassed, and provide a hardened overflow point so that the high water events would have less of a tendency to cut a bypass around these structures. The next step will be for the St. Paul District will gather whatever existing information is available for this site, while the MDNR will hold further internal discussions as to whether or not they want all flow to the lakes via Carter Slough cut off during normal river stages.

d. Coulters Island/Morgans Coulee - After Diamond Bluff, the Coulters Island dredge cut in next in order of significance in terms of dredging frequencies and quantities in pool 3. The Morgans Coulee dredge cut is also a relatively important dredge cut located just above the Coulters Island cut. The dredged material from these two dredge cuts is designated for placement in the Corps Island site located at river mile 799.2, approximately 2.6 miles from most frequently dredged portion of the Coulters Island cut and 3.5 miles from the most frequently dredged portion of the Morgans Coulee cut. This requires the material to be mechanically dredged and placed at the Corps Island site. If the Coulters Island/Morgans Coulee dredging requirements could be shifted to the Diamond Bluff area, the cost of channel maintenance in the lower pool 3 area would be reduced.

Jon Hendrickson indicated that the options for reducing dredging requirements in this area are to (1) reduce the loss of main channel flow to side channels such as Miley Run and the Brewers Lake inlet, (2) make the channel more efficient through wing dam modifications, or (3) a combination of the two. The study of measures to reduce dredging in this reach will incorporate habitat enhancement into the designs as much as practicable. Jon presented an example where if measures were proposed to reduce flow into Miley Run, how these measures could be designed to provide some localized fish habitat benefits.

e. North and Sturgeon Lakes - North and Sturgeon Lakes in the lower reaches of pool 3 are generally turbid with little aquatic vegetation. The opportunity may exist to improve fish and wildlife habitat conditions in these lakes. At present, deltas forming in these lakes at Mississippi River main channel inlets is providing some of the more valuable habitat in the lake as these areas seem to support some aquatic vegetation. We will be comparing historic aerial photos to determine the approximate rate and pattern of delta formation in these lakes. The effects of side channel measures evaluated under d. above on delta formation will need to be considered.

Island construction in these lakes would break up wind fetch, but their effectiveness in enhancing the growth of aquatic vegetation was questioned in the absence of measures to stimulate seed germination such as a pool drawdown.

It was noted that reducing inflow into these lakes from the main channel may benefit the Prairie Island Indian Community by reducing future maintenance requirements in the boat channel in lower Sturgeon Lake that connects the tribal dock facility with the main channel.

f. Lock Waiting Sites - Commercial tows at times have to wait for lockage. At present, there are no designated waiting areas for commercial tows below Lock and Dam 2 or at Lock and Dam 3. Generally, commercial tows "bump" up to the bank while waiting for lockage in whatever location in available. This has raised concerns that the tows on occasion tie up or hold their position in environmentally sensitive areas. In addition, because of the high levels of recreational craft use at Lock and Dam 3, the potential exists for conflicts or safety concerns between recreational and commercial users.

As part of this study we will try to identify lock waiting sites that are acceptable from a resource management perspective and will be used by the towing industry. We will also try to identify what would be necessary or appropriate at these sites to insure their use, e.g., mooring cells, mooring buoys, etc.

A map showing the location of eight potential lock waiting sites developed by towing interests was distributed. The resource management agencies were asked to review these site to determine if there were any that were obviously unacceptable from a resource perspective. They were also asked to identify any alternative sites that they would recommend from a resource perspective. We will try to screen the sites down to those acceptable to both the resource management agencies and the towing industry. These sites will then be evaluated in more detail. The Wisconsin DNR indicated that generally areas with water depths of less than 13 feet would not be considered acceptable as lock waiting areas due to potential effects on mussels.

g. Diamond Island Channel - Diamond Island is located on the right side of the navigation channel in upper pool 4 at river mile 795. There is a secondary channel on the back side of the island that at one time provided good fish habitat. Over the last decade or so, this secondary channel has shallowed due to sedimentation. It is believed this has been caused by the shifting outlet of the Cannon River. The loss of this secondary channel habitat is a concern because it is a relatively uncommon habitat type in the upper reaches of upper pool 4. We can develop a plan for restoring and maintaining the secondary channel behind Diamond Island.

Jon Hendrickson believes that the best opportunity for restoring this channel would be to direct Vermillion/Cannon River flows through this area rather than trying to force main channel flows behind the island. The resource management agencies agreed with this view. The District will proceed with developing a plan for restoring this channel using Vermillion/Cannon River flows while the MDNR will hold further internal discussions and begin making contact with the Red Wing Sportsman's Club (riparian landowner).

h. Wisconsin Channel - The Wisconsin Channel is a major secondary channel in upper pool 4, extending from river mile 793.5 to Lake Pepin. The Wisconsin Channel is considered a highly valuable resource, especially from a fishery perspective. Every opportunity should be taken to maintain this resource and prevent its degradation.

The only habitat change of note that is occurring in the Wisconsin Channel is that the amount of flow entering the channel leading to Dead Slough Lake is increasing, reducing the amount of flow in the Wisconsin Channel below this flow split. This in turn is believed to be increasing sedimentation in the lower reaches of the Wisconsin Channel. Resource managers view this as a natural change and that any lost habitat value in the Wisconsin Channel will be offset by habitat gains in the channel leading to Dead Slough Lake.

It was pointed out that there is private development along the lower portion of the Wisconsin Channel and that the public may express concern over the effects of sedimentation on recreational boat access in this reach.

i. Mud and Dead Slough Lakes - Mud and Dead Slough Lakes are shallow and turbid with little aquatic vegetation. After some discussion, we were unable to identify any practical habitat restoration or enhancement measures for these two lakes. Therefore, at this time, no further study effort will be expended at these lakes.

j. Head of Lake Pepin - There is a transition at the head of Lake Pepin where commercial tows leave the lake and enter the Mississippi River main channel. The sediments in this area are relatively fine and it is believed that the navigation channel to some degree is kept open by the commercial tow traffic itself. The navigation channel in this area apparently is not clearly defined, and commercial tows can select their own passage into the Mississippi River main channel. Concern has been expressed with the possible water quality effects of sediment resuspension by commercial tows and whether or not it would be better to have the navigation channel defined further out into Lake Pepin.

After some discussion, it was identified that from a water quality perspective (minimizing sediment resuspension), it would be desirable for tows traversing Lake Pepin to follow the deepest water possible. We will further evaluate if it is practical to designate preferred route(s) across Lake Pepin for tows to follow and if the tow boat operators would actually follow these routes.

3. The Minnesota and Wisconsin DNR's had submitted suggestions for wing dam notchings for fish habitat enhancement within the study area. Dennis Anderson had synthesized these recommendations along with some of his own for further review. We went through the synthesized recommendations and identified those locations where notchings should be considered further. Dennis will consolidate the recommendations from the meeting and provide them to the meeting participants.

4. Scot Johnson brought to our attention that it appears that changes in the tailwater elevation at L/D 3 have effects a considerable distance up the Vermillion River, and that these changes could be affecting aquatic plant growth in the Vermillion River system. We agreed to look into this further to see what the correlation between tailwater and Vermillion River stages may be, and if this is a problem, can anything be done about it?

5. We propose to hold some public information meetings on this study, probably in Prescott and Red Wing at each end of the study area. I indicated I would be contacting participants further concerning potential meeting dates.

Gary Palesh
Project Manager

Minnesota Department of Natural Resources

Lake City Area Office
1801 South Oak Street
Lake City, Minnesota 55041

612/345-5601

January 25, 2000

Mr. Gary Palesh, Technical Manager
U.S. Army Corps of Engineers, St. Paul District
190 Fifth Street East
St. Paul, Minnesota 55101-1638

Dear Mr. Palesh:

Re: Pool3/Upper Pool 4 Channel Management Plan Study - DRAFT Problem Appraisal Report

In response to your request for Minnesota Department of Natural Resources staff to review the Draft Problem Appraisal Report (PAR), we provide the following comments:

<u>General Comments</u>

1 Fish and Wildlife Habitat Problems and Opportunities - The Mississippi River is artificially perched above the Vermillion River Bottoms by the Pool 3 impoundment. In our opinion, the surface and groundwater hydrology changes in the Vermillion River Bottoms caused by the Pool 3 impoundment need to be better addressed in the PAR. The USGS Report 99-4069, "Water Resources of the Prairie Island Indian Reservation, Minnesota, 1994-1997", may be useful in this regard.

2 Lock and Dam 3 has been managed so that water levels are **at or above** the regulation manual's top of the operating range to accommodate commercial navigation and marina operations. This could be leading to accelerated shoreline and dike erosion, cause more water to spill into the Vermillion Bottoms during low flow periods, promote unnatural water level fluctuations (reversals and rise/fall rates) and numerous other possible affects on natural resources in the study area. We know that water levels as far up as the Etter Bridge on the Vermillion are controlled by tailwater water levels during low flow periods. The PAR should better address this issue by identifying the problems and opportunities to manage water levels differently at Lock and Dam 3 and 4. For example, managing water levels on the low end of the operating range while maintaining relatively steady tailwater water levels may provide improved opportunities for aquatic plants to become reestablished in the Vermillion Bottoms.

<u>Specific Comments</u>

3 1.4 It should be explicitly stated that water levels in the St. Croix River, upstream to Stillwater, are controlled by Lock and Dam 3, but that the St. Croix River is not included in the study reach.

4 1.5.6. The Recreational Boating Study was also completed in 1999.

5 2.5.2. The Fuller Mussel study is 30 years old. There have been profound changes to the mussel resources over the intervening years. Any reference to Fullers work must be explicitly qualified with a statement that the information is likely obsolete. A system wide mussel survey should be completed by the Corps to adequately address the mussel resources in the Channel Management Planning process.

6 2.6 There are at least two eagle overwintering roosts in the study area. One near the confluence of the Vermillion River with the Mississippi River and one between Red Wing and Wacouta. Please contact Joan Galli, DNR Non-game Program, for more information.

7 Table 2-6. We are unfamiliar with Commissary Point Campground. There is water access at Bay Point Park and Lake Rebecca Municipal Park (Jaycee Park).

8 3.2 Lower Pool 3 has lost large islands to erosion since the late 1960s. This loss should be quantified using GIS overlay maps.

9 4.4.1.1. Last Sentence. Is this sentence implying that a drawdown will make the training structures more efficient at moving sediment downstream and the river will self scour the main channel? If so why not explicitly state it instead of being so obtuse?

10 4.4.3. The backwaters will not likely revert to terrestrial meadows or floodplain forest unless wind-generated waves are dampened by physical structure within the backwater. Specific management actions, like an extended summer time water level reduction to stimulate emergent vegetation growth, is required. Otherwise, the backwaters will continue to be very shallow windswept water bodies with very little vegetation, loose flocculent sediments, poor water quality and degraded aquatic habitat.

11 5.1. While the Head of Lake Pepin Dredge cut was last dredged in 1990, the Corps has sent out Dredging Notices a few times since then stating that conditions warrant dredging. What has happened is that by the time the dredging plant is ready to start the job, the commercial tows have self dredged a channel with their props, resuspending the contaminated fine-grain sediments into Lake Pepin and making contaminants available for bioaccumulation in river organisms. This issue needs to be addressed in more detail within the PAR.

12 5.1.4. Not only do tows bump up to shorelines but they crush mussels, disturb aquatic habitat, erode sediments with their prop wash and kill trees. Last year a number of waiting tows in Upper Pool 4 were observed tied up to live trees who's roots were being pulled out of the banks.

13 5.2.5. Diamond Island Channel was the main channel until the Corps cut off the meander loop and made a secondary high flow channel the main channel.

14 5.2.7. Mud Lake is divided by Highway 63 into Upper and Lower Mud Lake. The vegetation in the Upper Mud Lake is much different than Lower Mud Lake. Please contact Megan Coulombe-Moore, Pool 4 LTRMP Field Station, for more information.

15 5.5.9. Lake Pepin is filling in quickly according to recent studies by the Science Museum. The upper third is forecast to be filled within 100 years. Are there opportunities to reduce dredging needs while creating better physical structure/aquatic habitat at the Head of the Lake? More discussion is needed in the PAR to better address this issue.

16 5.3.1. Recreational boating has accelerated shoreline erosion and degraded water quality in the study area. A 1994 study published by EMTC documents the impacts in the Red Wing area. This issue needs more discussion within the PAR.

17 5.3.3. and 6.1.8. The name of the marina is Trenton Island Marina not Red Wing Marina.

Thank you for the opportunity to comment. Please call if you have questions or concerns regarding our comments or recommendations.

Sincerely,

Scot Johnson

Scot Johnson
Mississippi River Hydrologist

cc. Jim Cooper, Waters, Rochester
Tim Schlagenhaft, Fisheries, Lake City
Dan Dieterman, Fisheries, Lake City
Mike Davis, Eco Services, Lake City
Jack Enblom, Eco Services, St. Paul
Mike Tenney, Wildlife, Winona
Diana Regenschied, Wildlife, Shakopee
Walt Popp, Eco Services, Lake City
Steve Johnson, Waters, St. Paul
Gary Wege, USFWS, Bloomington
Gretchen Benjamin, WDNR, LaCrosse
Brian Brecka, WDNR, Alma
Judy Mader, MPCA, St. Paul
Craig Wills, Prairie Island Community

Responses to Comments Provided by the Minnesota DNR dtd January 25, 2000

1. A narrative has been added to section 5.2 addressing this subject. The changed conditions in the Vermillion River bottoms brought about by the creation of pool 3 is not something we can have much effect upon under the channel management program, and therefore, we are not going to expend much effort evaluating under this study. It would likely require a significant change in water level regulation for pool 3 to effect any measurable change in the Vermillion River bottoms.

2. We consider it beyond the scope of the channel management studies to assess the ramifications of pool regulation and/or potential changes to pool regulation, either at Lock and Dam 3 or elsewhere. We believe these issues are best addressed by and through the Water Level Management Task Force. One observation we can make is that tailwater elevations are primarily a function of river discharge over which the St. Paul District has minimal control. We regulate pool levels to maintain adequate depths for commercial navigation. As a result, tailwater elevations tend to fluctuate based on river discharge. If we attempted to regulate the dams for specific target tailwater elevations, the result would be widely fluctuating pool levels.

3. This information has been added to the referenced section.

4. The noted addition has been made.

5. We recognize that Fuller's survey is a very valuable but dated survey. It was conducted primarily to assess the effects of continued channel maintenance for the 9-Foot Navigation Channel project. In the Federal and State biological assessments prepared as part of the 1997 EIS for the Channel Maintenance Management Program, we assessed the potential for impacts on Federal and Sate listed mussel species. Many of the dredging and placement sites were determined to have "no effect" on designated species. This determination was based on a variety of factors including: the frequency of dredging; the physical and chemical characteristics of the material normally dredged; the results of previous surveys including Fuller's, WDNR's, and other surveys performed by COE and others; and other factors. Several dredging sites, placement sites, and recreational beach development sites were determined to need more updated survey information, before a final determination could be made. Since the issuance of the Final EIS we have undertaken mussel surveys at some of these sites and will continue to complete these surveys as time and logistics allow. Several dredge cut areas in pools 3 and upper 4 were listed as having insufficient information. We will perform mussel surveys of these areas and other areas proposed for channel control structure modifications this year as part of the channel management planning. We do not feel that a system wide mussel survey is the responsibility of the Corps. State natural resource agencies and U.S. Fish and Wildlife Service should be conducting these life history/population status surveys as part of their natural resource management responsibilities on the UMR.

6. We have updated this section to indicate the presence of the two bald eagle roosting areas in the study reach.

7. The Commissary Point Campground has been removed from the table and the availability of boat launch facilities at the other two sites has been noted..

8. This does not appear to be the case. A review of aerial photos from 1938 and 1973 indicates that North and Sturgeon Lakes (the two large open water areas in lower pool 3) have been relatively devoid of islands since the creation of pool 3. We do propose to do a GIS analysis of the changes to these lakes during the next phase of study, primarily to assess changes in delta formation and changes to the barrier islands.

9. The referenced statement has been revised to make it clearer. Prior to the locks and dams, the training structures dominated conditions on a pool-wide scale (i.e., if you looked at a map, you would notice prominent river banks that were wide and high, or a backwater channel that was a certain size because of the closing structure at its upstream end). After the locks and dams were completed, pool-wide conditions became dominated by the effects of the dam itself. Backwater conditions were less effected by the submerged training structures and more by the submergence of the entire floodplain by the dam, and the tendency for floodplain flow to increase with time. If we were to lower water levels, the training structures would become more effective, and flow through backwaters would be influenced more by closing dams.

10. In the lower open areas of the pool and large backwater lakes, we concur with your conclusion regarding the growth of land forms, at least in the immediate future. We in fact concluded in section 4.4.3 that "Within the 50-year planning horizon, a substantial increase in terrestrial habitat is not likely to occur." However, sediment accretion is still occurring in these areas, especially bed load material. Eventually, as the areas become shallower, land will begin forming, as it is presently doing in pool 6. The northeast corner of Sturgeon Lake maybe approaching the point where new land is forming. Once these areas start forming land barriers, a more rapid formation of terrestrial habitat is likely. In addition, in more protected backwaters like the Big Lake area in lower pool 4, aquatic areas have been and will continue to be converted to land.

11. This is an issue that will need to addressed during the next phase of study. The concern with bioaccumulation has been added to the discussion in section 5.2.9.

12. This information has been added to the referenced section.

13. This information has been added to the referenced section.

14. The referenced section has been modified to reflect that Lower Mud Lake is the portion of the lake with degraded habitat.

15. This is a question that will need to be answered during the next phase of the study. Opportunities to improve habitat will be identified and evaluated (see section 8.1.2.10).

16. This information has been added to the referenced section.

17. This correction has been made.

DEPARTMENT OF THE ARMY
ST. PAUL DISTRICT, CORPS OF ENGINEERS
ARMY CORPS OF ENGINEERS CENTRE
190 FIFTH STREET EAST
ST. PAUL, MN 55101-1638

REPLY TO
ATTENTION OF

NOV 30 1999

Project Management Branch
Planning, Programs, and Project Management Division

SUBJECT: Pool 3/Upper Pool 4 Channel Management Study

Dear River Resources Forum:

Enclosed for your review is the draft Problem Appraisal Report for Pool 3/Upper Pool 4 Channel Management Study. Please review this document and provide any comments you may have by January 21, 2000.

If you have any questions please contact me at 651-290-5282 or at gary.d.palesh@mvp02.usace.army.mil.

Sincerely,

Gary Palesh
Project Manager

Enclosure

UNITED STATES DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
TWIN CITIES FIELD OFFICE (ES)

This project has been reviewed under the authority of and in accordance with provisions of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; U.S.C. 661 et seq.), the National Environmental Policy Act and the Fish and Wildlife Service's Mitigation Policy. This proposal was also examined for its conformance with the Endangered Species Act of 1973, as amended, and Executive Orders 11988 and 11990.

There are "No Objections" to this project as reviewed under the above Acts, Policy or Orders. This approval is given with the understanding that the applicant will comply with any recommendations made by the Minnesota and/or Wisconsin Departments of Natural Resources.

NAME: Gary J. Wege DATE: 1/26/00

F-27

TITLE: Fish and Wildlife Biologist

24 February 2000

Notes from telephone conversation with Scot Johnson

Subject: Pool 3/Upper Pool 4 Channel Management Study

I received a telephone call from Scot Johnson re: the subject study. The Minnesota DNR held an internal meeting this week at which they discussed the study. The following summarizes Scot's points.

1) Scot asked what the relationship was between the navigation work group mooring cell study and this study re: mooring cells. I told him we would continue to include lock waiting areas in this study and hopefully, through coordination with the navigation work group, develop recommendations consistent with the navigation work group efforts.

2) At Carter Slough, any restoration of the spot dike should be in the form of a weir without a culvert. The MDNR doesn't believe there is enough of a fishery in Mud Hen and Round Lakes to worry about providing flow via Carter Slough. Also, maintaining a culvert in this location would probably be an O&M headache.

3) There are mixed views within the MDNR concerning restoring the channel behind Diamond Island. However, the MDNR will initiate talks with the Red Wing Wildlife Club to see what their concerns might be. Joan Galli is concerned about potential effects upon winter eagle roosts. I told Scott I would have Dennis Anderson talk to her directly to discuss the specifics of her concerns.

4) Miley's Run is the primary access route for small boats around the closed area at North Lake. Therefore, we must maintain this access. It appears depths in Miley's Run are marginal so if we implemented a project at this site, anything that would improve water depths would be viewed positively. In general, the MDNR does not want to see any reduction in flow through Miley's Run or the Brewers Lake inlet. I told Scot we would have to look at how much flow would need to be reduced for us to achieve any channel maintenance benefits.

5) There is a poor public boat access at the north end of North Lake. Scot wondered if there was anything we could do at this site to improve this access point. Since it appears from the navigation chart that we own the land in this area, I told Scot I would discuss with Dick Otto.

6) Scot wondered if there was anything that could be done at the "Three Corners" structure in the Vermillion River near Hastings that would make this structure an asset if pool regulation changes (drawdown) was implemented in pool 3. I told Scot I would have to talk to Don Powell to find out more about this structure (apparently it was looked at during the Goose Lake HREP study).

7) The reaction of the fishery biologists familiar with the L/D 2 area was positive concerning possible construction of an island and secondary channel at the flats below L/D 2. We should continue investigating this possibility.

8) The MDNR would like us to look into the feasibility of constructing a sediment trap at the head of Trenton Island to reduce dredging requirements in upper pool 4 and reduce the sedimentation rate in Lake Pepin. The dredged material could be placed in a large sand and gravel pit on the Wisconsin side owned by Mr. Holtz. I told Scot we would take a look at this.

9) A junk car is located in one of the side channels in pool 3. Scot wanted to know if we could haul it out of there. I told him to send me a map showing the location and we would look into it.

Gary Palesh
Project Manager

DEPARTMENT OF THE ARMY
ST. PAUL DISTRICT, CORPS OF ENGINEERS
ARMY CORPS OF ENGINEERS CENTRE
190 FIFTH STREET EAST
ST. PAUL, MN 55101-1638

REPLY TO
ATTENTION OF

March 9, 2000

Project Management Branch
Planning, Programs, and Project Management Division

SUBJECT: Pool 3/Upper Pool 4 Channel Management Study

Dear River Resources Forum Member:

Enclosed for your information is the Problem Appraisal Report of the subject study.

If you have any questions or need additional copies of the report, please contact me at 651-290-5282 or at gary.d.palesh@mvp.usace.army.mil.

Sincerely,

Gary Palesh
Project Manager

Enclosure

E-30

Public Information Meeting

Pool 3 - Upper Pool 4 Channel Management Study

St. Paul District, Corps of Engineers

The St. Paul District, Corps of Engineers, is conducting a study to improve management of the navigation channel in pool 3 and upper pool 4 of the Upper Mississippi River. The primary purposes of the study are to identify measures that would (1) reduce channel maintenance requirements, (2) improve navigation safety, (3) restore and enhance fish and wildlife habitat, and (4) maintain or improve recreational opportunities. **A public information meeting for the study is scheduled as follows:**

Date:	**March 27, 2000**
Time:	**5:00 p.m. to 8:00 p.m.**
Location:	**Red Wing Public Library** **Community Room** **225 East Avenue** **Red Wing, Minnesota**

The primary purpose of the meeting will be to provide information concerning the study and to solicit public input concerning channel maintenance, navigation safety, environmental concerns, recreational opportunities, or any other matter related to maintenance of the navigation channel in pool 3 and upper pool 4.

The meeting will be conducted as informally as possible using an open house format to allow members of the public to view study materials and to talk with Corps of Engineers staff and representatives of Federal and State resource management agencies. Individuals can come to the meeting at any time within the time period noted above. **Attendance for the full three-hour time period is not necessary.** A short (~ 15 minutes) presentation will be given at **6:00 p.m.** and at **7:00 p.m.** discussing the study and its purpose.

This study is not related to the Lock and Dam 3 Embankment Project. Information concerning that project will not be presented at this meeting.

If there are any questions concerning this public information meeting, please contact Gary Palesh, Project Manager, at (651) 290-5282 or at gary.d.palesh@mvp02.usace.army.mil.

CEMVP-PM-A 19 June 2000

MEMORANDUM FOR: See Distribution

SUBJECT: Pool 3/Upper Pool 4 Channel Management Study

1. We have the hydraulic model for pool 3 up and running and are beginning to evaluate some alternatives. The enclosed information is to provide you a look at what we are having our hydraulics contractor initially model.

2. The picture files do not have a depth scale on them. The following is provided for your reference (you can also compare to the bathymetry maps we provided in the past).

light green	0-2 feet	magenta	10-12 feet
medium green	2-4 feet	blue	12-15 feet
dark green	4-6 feet	dark blue	15-20 feet
yellow	6-8 feet	pink	> 20 feet
red	8-10 feet		

3. We are not proposing any of these features at this time, as we need to obtain the hydraulic modeling results, develop cost estimates, evaluate potential effectiveness, and assess potential environmental effects. Therefore, I am not requesting any comments. However, as you look this information over, if you have any thoughts or concerns that immediately come to mind, please provide them.

4. This package only covers items we are modeling. There are other features we will be developing proposals for in the near future, e.g., Carter Slough, Diamond Island, etc., which I will send out for your info/review as soon as they become available.

5. If you have any questions, please contact me at (651) 290-5282 or at gary.d.palesh@mvp02.usace.army.mil.

Encl

Gary Palesh
Project Manager

Distribution:
Gary Wege, USFWS
Scot Johnson, MDNR
Jack Enblom, MDNR
Gretchen Benjamin, WDNR
Brian Brecka, WDNR
Heather Westra, Prairie Island Community
Paul Machajewski, COE

CEMVP-PM-A 2 August 2000

MEMO FOR: See Distribution

SUBJECT: Pool 3/Upper Pool 4 Channel Management Study

1. The purpose of this memo is to provide you with an update on the subject study and to solicit some feedback concerning certain project features.

a. Lock and Dam 2 Lateral Current – We have received the results of hydraulic modeling for three guard wall extension options (see the June 19, 2000 package I sent to you). An initial review indicates that alternative 1 (600-foot emergent guard wall extension) may be the best option for further consideration. Alternative 2 (1,600-foot emergent guide wall extension) would have too much of a change on hydraulic conditions, while alternative 3 (700-foot submerged guard wall extension) would have only an insignificant effect on alleviating the lateral current problem.

We consider it beyond the scope of our channel management studies to recommend implementation of structural modifications at the locks and dams, as these modifications generally require considerable more engineering analysis than we normally do for typical channel management structures such as wing dams, partial closures, and bank protection. In the Pool3/Upper Pool 4 channel management report, we propose to document our studies, identify if there appears to be an engineering solution(s) to the problem, the approximate cost, and identify any environmental concerns with the potential solution(s). If it looks like there may be a feasible solution, we likely will recommend further study of this feature.

Feedback required by September 8, 2000: What concerns would you have with construction of a guard wall extension below Lock and Dam 2 using an emergent rock dike design?

b. Lock and Dam 2 Flats – We have received hydraulic modeling results for a few island construction options (see June 19 package) for the shallow area below L/D 2. We are developing an island design to a sufficient degree to come up with a cost estimate. This estimate will tell us if we are in the ballpark as to whether or not we could pursue this as a dredged material placement option.

c. Carter Slough – We have not done much work on this site yet. A 1987 study contracted by the District with a consulting engineering firm recommended a fix at this location that involved constructing two additional small spot dikes at breakout points (attachment A). The draft Goose Lake HREP report in 1990 recommended constructing a new single spot dike closer to the Carter Slough entrance (attachment B). The Goose Lake study team selected this design over the 1987 design because of easier construction access. We are currently reviewing these designs. If we were to recommend one of these designs, it would not include the culvert with a slide gate as shown on these old plans, nor would we likely be doing the channel improvement shown on attachment A.

Feedback required by September 8, 2000: Do you have any concerns with construction of a spot dike at either of the locations shown on attachments A and B?

d. Four Mile Island - We have received the results of hydraulic modeling for the options described in the June 19 package (wing dam rehab at about river mile 807.5). The results indicate that the navigation channel benefits would not be sufficient to pursue the wing dam modifications any further from a channel maintenance/navigation perspective. Modification of the wing dams would induce scour and increase bathymetric diversity in the channel behind the island, and thus may warrant further consideration from a habitat improvement perspective.

Feedback required by September 8, 2000: Are you interested in having us evaluate this modification further for the habitat benefits that may accrue? Be aware that this is not a wing dam notching proposal. The design calls for making portions of the wing dams behind the islands emergent structures.

e. Big River - We have received the results of hydraulic modeling for the options described in the June 19 package (wing dam rehab at about river mile 805). At present, it appears that alternative 1, rehabilitating the four wing dams on the Wisconsin side of the channel at river miles 804.9, 805.1, 805.2, 805.25, is the only one worth considering further re: potential channel maintenance/navigation benefits.

Feedback required by September 8, 2000: Do you have any concerns with rehabilitation of these four wing dams?

f. Morgans Coulee/Coulters Island - We have received the results of hydraulic modeling for the options described in the June 19 package (Brewer's Lake inlet, Miley Run and an unnamed opening at river mile 802.3L) and are currently analyzing the results. An initial review indicates the options analyzed will not accomplish the navigation channel changes we had hoped for. We will likely be doing additional evaluation of other options in this reach.

g. North and Sturgeon Lakes – We have prepared maps from 1939, 1973, and 1998 aerial photographs (enclosed). The 1998 map shows the 1939 shoreline. The dates and water surface elevations at Lock and Dam 3 for these photos were:

June 20, 1939	673.4
August 20, 1973	674.0
April 29, 1998	674.3

We will be doing some additional analysis of the aerial photo record to evaluate interim changes during the 1939-98 time period.

At the present time, it appears that one potential habitat restoration or enhancement measure that would benefit Sturgeon and North Lakes would be island construction to diversify habitat and to provide some wind/wave protection to reduce sediment resuspension. Construction of islands could be pursued under any number of cost-shared programs such as EMP, Section 1135, Section 206, or Section 204. If we assume that the sand bases of any island constructed would be constructed with channel maintenance sand, then Section 204 would be the most advantageous to a non-Federal sponsor. The only portion of the island that would need to be cost-shared would be the cost above and beyond the cost of placing the sand in an approved placement site, in this case, Corps Island.

We may also be able to pursue island construction in North and/or Sturgeon Lakes as part of our channel maintenance program, similar to what we are doing in lower pool 5. Before we would pursue island construction under the channel maintenance program, we would like to begin implementing the lower pool 5 plan to see how it works out and if there are any unexpected problems or costs associated with this approach.

Feedback required by September 8, 2000: Are the Minnesota DNR or the Prairie Island Community interested in island construction in North and/or Sturgeon Lakes? If the response is yes, would you be interested in pursing this under a cost-shared program or only under our channel maintenance program where the costs would be 100% Federal? An indication of interest in a cost-shared program will not be viewed as a commitment of any kind on your part. All we would do in the report is identify that there is an interest and outline follow-up actions that would be required.

h. Diamond Island – We have not done any work for this location yet. We will develop a design in the near future for your review.

i. Wisconsin Channel, Lower Mud Lake, and Dead Slough Lake – We have not identified any structural modifications for habitat restoration or enhancement in these locations and will not be doing any further work unless someone identifies a defined project or measure they would like considered.

j. Head of Lake Pepin - We have not identified any structural or other measures in this reach that would address the concern of resuspension of sediments by tows. As with the previous sites, we probably will not be doing any further work unless someone identifies a defined project or measure they would like considered.

k. Lake Pepin – We have developed a bathymetry map for the lake (enclosed). The concern expressed during the problem identification process was with sediment resuspension due to tow passage. I don't know what the next step should be. We can include this map in the report and recommend that commercial tows try to pass through Lake Pepin over the deepest water possible.

Feedback required by September 8, 2000: Any ideas on implementable actions, i.e., have the Coast Guard designate a preferred route through the lake, request the towing industry to avoid the areas <20 deep, or ????

1. Wing Dam Notching – Due to other priorities, we have not been able to develop a wing dam notching plan for the study area as of yet. Our goal is to provide a draft plan to you by about the third week of August.

2. We have reversed an earlier decision and decided not to address lock waiting sites as part of this study. The District prefers at this time to address lock waiting sites as a separate District-wide program to insure consistency in policy and design throughout the District if and when these measures are implemented.

3. After we receive the feedback asked for by September 8, we will develop an agenda for the October 11 coordination meeting. If you have any questions, please contact me at (615) 290-5282, or at gary.d.palesh@mvp02.usace.army.mil.

Encl

Gary Palesh
Project Manager

Distribution:
Gary Wege, USFWS
Scot Johnson, MDNR
Jack Enblom, MDNR
Gretchen Benjamin, WDNR
Brian Brecka, WDNR
Judy Mader, MPCA
Heather Westra, Prairie Island Community
Paul Machajewski, COE

CEMVP-PM-A 25 August 2000

MEMO FOR: See Distribution

SUBJECT: Pool 3/Upper Pool 4 Channel Management Study

1. Enclosed for your review is a draft wing dam notching plan for pool 3 and upper pool 4. Please review this information and provide any comments by September 29. The wing dam notching plan will be an item for discussion at the October 11 coordination meeting.

2. If you any questions specific to the draft wing dam notching plan, please contact Dennis Anderson at (651) 290-5272. If you have any other questions pertaining to the study or the October 11 meeting, please contact me at (615) 290-5282, or at gary.d.palesh@mvp02.usace.army.mil.

Encl

Gary Palesh
Project Manager

Distribution:
Gary Wege, USFWS
Scot Johnson, MDNR
Jack Enblom, MDNR
Gretchen Benjamin, WDNR
Brian Brecka, WDNR
Judy Mader, MPCA
Heather Westra, Prairie Island Community
Paul Machajewski, COE

9-6-00
ld34.wpd
G. Wege

Gary:

Here's some comments per your 8-2-00 memo on Pool 3/Upper Pool 4 Channel Management Study:

1. Emergent Guardwall below LD2.

Concerns include:

extent of flow changes in tailwater habitat
any anticipated O&M channel dredging needs due to project
mussel impacts
any conflicts with proposed mooring cell/piling location below LD2
eagles nest fairly close to the project site (Lake Rebecca) and also use LD2 tailwater for winter feeding so may need to schedule construction activities depending on construction methods/timing.

2. Spot dikes

We are dropping the culvert/gate and dredging because we are dropping the HREP?? I don't have any specific concerns with locations. Any mussel surveys done already??

3. I would be interested enough to see how much area would be affected — are we gonna get a puny little scour hole or something like the diverse depths/area at 807.9??

4. Pool 3 still has zeeb free mussels — will need mussel surveys. Any habitat benefits of putting a small notch in them when constructed (upstream one 805.2?? looks like it has pretty good depths already so probably don't need one there — the rest don't have a whole lot of depths behind them)? I don't think a small notch or two here and there would drastically affect channel efficiency benefits.

5. N/A

6. Lake Pepin Channel — I still like the idea of a marked channel as it would seem to prevent sediment displacement over a wide area in the upper lake. I am not sure how difficult it is to mark the channel in deep water, but if that is no big deal, I would like to see a marked channel throughout the lake. Seems like it would be better to concentrate the impacts of barge traffic in one (deep) place versus letting them navigate anywhere. Do you/CG/industry have some sort of map showing where they usually navigate now??

Hope these help. Bye!

Gary Wege

Gary Palesh, Project Manager
USACE
190 5th Street
St. Paul, MN 55101-1638

Re: Feedback on the August 2, 2000, MEMO "Pool 3/Upper Pool 4 Channel MGMT Study"

Dear Sir,

This letter is regards to the feedback specifically requested from the Prairie Island Indian Community in the above mentioned Memo.

Item 1f: The meeting that was held down in Lake City on January 19th, 2000, was about the time that I had just started working for the PIIC. At that time I did not have the understanding of the issues to properly opine on the matter of restricting flow from Miley and Brewer runs. I would like to suggest that the Corps does not alter these runs. The area(s) downstream of the runs have been gaining islands in the past few years (which is a good thing), they create variable depths, provide much needed heterogeneity in habitat, and finally, the runs provide a pretty good fishery(s) for this area.

- In the 1999 Draft Problem Appraisal Report for the "Pool 3/ Upper Pool 4 Channel Management Study" goals were identified.
  Goal #1 6.3.2.1 Restore and enhance natural river processes (page 6-5)
  Goal #2 6.3.2 Restore and enhance habitat quality and diversity with the study area (6-5)

I would hope that you take into consideration that by redirecting flow from these runs the above mentioned goals will not be achieved in pool 3. . I would also like to receive the stage/discharge information for the runs. I would use this information as part of a water quality monitoring project that I am working on.

Item 1g: Once information is available from the lower pool 5 plan we would greatly appreciate information relating to island construction and discussion regarding the feasibility and outcomes of establishment of islands in Pool 3.

The maps 1939, 1973, and 1998 shorelines demonstrate that the heterogeneity of the shoreline has been compromised. And, it is not so much needed to have islands created , as it is to have variable pool stages to enhance conditions for submergent and emergent aquatic plants. I have been throughout North and Sturgeon Lake and I have seen numerous shallow areas that would create ideal vegetation establishment areas, if pool 3 experienced periodic drought conditions. If pool 3 is managed at the current level, a reduction in the emergent and submergent habitats will keep increasing in rate.

If you have any questions or concerns, please contact me at (800) 554-5473 ext 4193, or fax at (651) 385-4110.

Craig Wills,
Water Resource Specialist

Cc: Heather Westra, Prairie Island Indian Community

5636 Sturgeon Lake Road • Welch, MN 55089
(651) 385-2554 • 800-554-5473 • Fax (651) 388-1576 • TTY 800-627-3529 Deaf or Hearing Impaired

Palesh, Gary D MVP

From: Benjamin, Gretchen L [BenjaG@mail01.dnr.state.wi.us]
Sent: Friday, September 08, 2000 11:27 AM
To: 'Gary Palesh'
Cc: Benjamin, Ron; Brecka, Brian J.; 'Gary Wege'; Janvrin, Jeff A; 'Scot Johnson'; 'Mader, Judy'; Sullivan, John F (DNR - LaCrosse); Wetzel, John F
Subject: CMP Pool 3 and Upper 4

Gary,

Here are some of my thought on your August 2 memo. Gretchen

Dear Gary:

Here are my comments on the Memo for Pool 3 and Upper 4 Channel Management Study.

Item a. I am comfortable with the approach you outlined for the L&D 2 outdraft problem. I believe the report should clearly state that the solution should be further investigated and implemented as soon as possible.

The project would be completely within Minnesota waters but as the neighboring state we recommend a mussel survey for the area in and around the footprint of the guide wall extension. We are also concerned with any dredging that will occur as a result of the project knowing there are some contaminant issues around L&D 2.

Item b. No comments at this time.

Item c. First of all, we will defer to Minnesota's expertise on this subject. However, I do not know the reason behind recommending two structures in the 1990 HREP for Goose Lake but it would seem the construction of only one structure would reduce the impacts to the area we are trying to protect. Also the culvert was probably an important element of the project so dropping the idea should be carefully considered.

Item d. I do not have my June 19th package with at me at home today. I will send comments on Monday when I can see precisely what you are describing.

Item e. Wingdam rehabilitation to original design is allowed without a Wisconsin 30.12 permit. Should the Corps want to extend or raise any of these four structures it will require a 30.12 permit. It will take at least 60 days to obtain that permit and will require detailed plans to issue the permit.

Item f. No comments at this time.

Item g. These projects are located in Minnesota and Prairie Island Community waters so we will defer to their expertise.

Item h. No comments at this time.

Item i. The Wisconsin Channel area is a quality habitat and we do not want this area to change as a result of other actions taken with the Channel Management Plan. We probably won't identify any structural changes but we watch the area of signs of habitat quality change.

Item j. The Head of Lake Pepin area includes a dredge cut that appears from time to time. It has not be dredged due to the fact we do not have anywhere to go with the material because it contain low levels of PCBs. This problem needs to be solved and if it's not structurally then it will probably have to be done by dredging. I don't believe you can drop work on this particular problem or you may be faced with a channel closure.

Item k. This information should be given to the Coast Guard and they should set up a primary channel with a secondary channel marked for strong winds. It appears the primary channel would follow relatively close to the Minnesota shore. In most wind conditions it would be better to be on that side of the channel anyway. However, a secondary channel could be marked closer to the Wisconsin shore if wind conditions were such that commercial navigation needs the protection of the opposite shore.

DEPARTMENT OF NATURAL RESOURCES

STATE OF MINNESOTA
OFFICE MEMORANDUM

DATE: September 11, 2000

TO: Gary Palesh, Project Manager, Pool 3/Upper Pool 4 CMP

FROM: Scot Johnson, DNR Waters, Lake City
scot.johnson@dnr.state.mn.us

SUBJECT: Comments on your latest two mailings

First off, thanks to Dennis and Tim for the mussel information. We will be looking over their data before the October meeting. Mike Davis is compiling mussel data he collected this summer. We hope to be able to provide Mike's additional info by the October 11 meeting. Mussels are a concern at all of the locations we are talking about doing work. This will probably be a main topic at the upcoming meeting.

In addition and to the extent possible, we want to make sure that what ever actions we take that we do not encourage the establishment and recruitment of zebra mussels in the study reach.

Here are our specific thoughts regarding the questions you posed in the August 2 mailing:

1. Guard Wall Extension - An emergent rock dike design 600 feet long seems reasonable. We would be most concerned about any possible mussel impacts.

2. Lock and Dam 2 Flats - We would like to see an island and side channel designed for this area. The side channel should start at the head of the island (not in the middle of the island) and run between the island and shoreline. The area is shallow, mostly sand with little mussel resources. There is a newly emerged island with a slightly deeper channel between it and the shoreline that should be incorporated into the island design.

3. Carter Slough Closure - We favor the single structure without a culvert (alternative B). Would it be possible to raise the weir crest by a foot or two (from to 677.5 to 679) to protect the Mud Hen Lakes from higher stages and their associated sediment load?

4. Four Mile Island Secondary Channel - There are actually two proposals on the table and we would prefer a combination of the two. The two proposals include 1) the emergent structures and closure or 2) wing dam notching. We would like to see the wing dam notching completed and, to the extent possible, use the excavated materials to build higher the wing dams (higher but not necessarily 2 feet out of the water) and the closure across the one opening. No habitat evaluation would needed since it would be completed by O&M during wing dam notching.

5. Big River Wing Dams - It appears as though Alternative 1 includes raising of the wing dams on the existing footprints up to 671 in elevation. If this is correct, at this point we have no large concerns but would like to see the wing dams notched.

6. Coulters Island Secondary Channel - This channel is diverse in bathymetry and we would not support a closure at the upper inlet.

7. North and Sturgeon Lakes - The GIS maps clearly show a loss of islands, especially in the lower end of Sturgeon Lake. We are interested in island construction in North and Sturgeon Lake using O&M materials. Please put together a preliminary proposal on where islands might be appropriate and feasible. Perhaps the developing Pool 3 Pool Plan would assist in the drafting of a preliminary design. Could the rebuilding of the lost islands at the lower end of Sturgeon Lake reduce inflow at Mileys, Brewer and Sturgeon Lake inlets and eliminated/reduce the need for structures at these locations?

Ken Muller, NSP at Prairie Island, is very familiar with the changes in the area. We suggest you contact him or invite him to the next meeting to get his input on this issue.

8. Wisconsin Channel, etc... - There has been a lot of changes in the Wisconsin Channel, Funks Cut, 3rd, 4th, and 5th Cuts. Locals may have some concerns and ideas on what should be done. We do not necessarily believe the changes seen represent a degradation in riverine habitat, but we should discuss this area again with the agency folks to see if there are concerns regarding the changes.

9. Lake Pepin - We feel that a sailing line (perhaps two sailing lines to accommodate wind direction) should be delineated in the deepest part of the lake - especially at the head end. Instead of navigation cans, we suggest that GPS coordinates for the sailing line or range lights be provided by the Coast Guard.

10. Wing Dam Notching - While we have not given this plan an exhaustive review, we are supportive of the proposal. However, it is contingent on our review of the mussel data sets. We also have some concern that we have not yet done an assessment on the Pool 5 and Pool 8 wing dam notches. I know we will be discussing the issue of when to complete the post notching bathymetric surveys at the October 11th meeting and perhaps we can come to an agreement then on when to proceed with the Pool 3 plan.

New Idea - A secondary channel that use to flow into the bottom end of Conley Lake (RM 813.8L) is blocked by a huge log jam at the upper end. The reintroduction of some flow into this back channel could help keep the marina channel open while improving secondary channel habitat.

We are looking forward to reviewing and discussing your proposals for the Diamond Island secondary channel, Mileys Run, Brewer Lake inlet, Sturgeon Lake inlet and the Vermillion River's Three Bridges Structure.

Thanks!! See you on October 11th.

Palesh, Gary D MVP

From: Mader, Judy [judy.mader@pca.state.mn.us]
Sent: Monday, October 02, 2000 9:22 AM
To: 'Palesh, Gary [COE]'
Cc: 'Benjamin, Gretchen [WI DNR]'; 'Johnson, Scot [DNR]'; 'Wege, Gary [USFWS]'; 'Machajewski, Paul [COE]'
Subject: comments on proposed wing dam notching in Pool 3/Upper Pool 4

Gary:

I apologize for being late with my comments -- I could blame John Bailen and the LD 3 embankment issues for having the same deadline, but ultimately it is my fault for not budgeting my time better.

Anyway, I have looked over the proposed locations for notching wing dams and have the following comments.

First and foremost, I do not see any serious water quality issues with notching the wing dams, so I will defer to the fisheries and habitat experts as to the value of notching specific wing dams.

Secondly, I noticed that the proposed notches varied in depth within wing dam fields and I am curious as to why that is.

Third, either the wing dams are labeled incorrectly -- as being on the right descending bank instead of left -- or the illustration of the notch locations is wrong for the wing dams on plate 7. This makes a difference not just in where we want the flow to go, but also in who has to approve the plan for these -- either WI or me.

Fourth, would notching the last two wing dams listed -- 797.6L and 797.5L -- have any impact on the outdraft and /or embankment problems at LD3?

And, finally, would notching 807.6R deeper than the proposed 5 feet do a better job of drawing flow to it?

Judy M.

F-44

CEMVP-PM-A 12 October 2000

MEMORANDUM FOR RECORD

SUBJECT: Pool 3/Upper Pool 4 Channel Management Study

1. An interagency coordination meeting was held on 11 October 2000 at the Fountain City Service Base concerning the subject study. Meeting attendees included:

Dennis Anderson	PM-E	Judy Mader	MPCA
Gretchen Benjamin	WDNR	Leon Mucha	CO-LD
Brian Brecka	WDNR	Gary Palesh	PM-A
Jon Hendrickson	ED-H	Gary Wege	USFWS
Scot Johnson	MDNR	Craig Wills	PIIC
Paul Machajewski	CO-CH		

2. The following items/features were discussed at the meeting.

a. Lock and Dam 2 Lateral Current - The St. Paul District has modeled three alternatives for the lateral current problem at the lower approach to L/D 2. The best engineering solution of those modeled is a 600-foot long emergent rock dike. The District is proposing that this option be the subject of more detailed study. The resource management agencies have no objections to proceeding in this manner. The study would be added as a line item in the 2002 O&M budget request. Initiation of the study would be dependent upon receiving study funds.

The question was raised as to how significant is this problem? Jon Hendrickson indicated that we looked into it because representatives of the towing industry had mentioned the lateral current below L/D 2 as a problem. Implementation of a solution would need to be based on further study and an evaluation of the costs vs. the potential benefits.

b. Lock and Dam 2 Flats – We have been investigating the option of using dredged material to construct an island below L/D 2 for the purpose of habitat enhancement. A preliminary cost evaluation indicates that the District would not be able to pursue this option as a least cost environmentally acceptable method of dredged material placement. The additional costs for stabilization, topsoil, and seeding would be more than double a liberal estimate of the savings associated with the placement of the dredged material. The Minnesota DNR indicated that they would not be interested in pursing this feature under a cost-shared program such as Section 204, Section 1135, etc.

c. Carter Slough – The existing Carter Slough spot dike is being bypassed, though not in a manner that immediately threatens the integrity of pool 3. In the long term, this is a situation that eventually will have to be addressed. The Minnesota DNR has expressed concern that the bypass flows are degrading habitat quality in Mud Hen Lake. A design has been developed for constructing a new spot dike at the entrance to Carter Slough. The agencies support construction of this feature.

d. Big River – The District is investigating rehabilitation of 4 wing dams on the Wisconsin side of the navigation channel at river miles 804.9, 805.1, 805.2, and 805.25 to improve channel conditions for commercial navigation. The wing dams would be restored to elevation 671.0, 4 feet below project pool elevation. They would not be restored beyond their original length. Two of the wing dams would be notched to promote localized bathymetric diversity for fish habitat enhancement.

The agencies do not oppose this action. The District still needs to develop a cost estimate and determine if the potential navigation benefits justify the costs of the project.

e. North and Sturgeon Lakes – Island construction is a potential habitat restoration measure for North and Sturgeon Lakes. A preliminary evaluation indicates that it may be cost effective for the District to construct islands in these lakes using channel maintenance material, provided additional costs for stabilization, topsoil, etc., are kept to the minimum.

While the idea of island construction in these lakes has been discussed in the past, no serious look has ever been taken at this matter. The Fish and Wildlife Work Group (FWWG) is in the process of developing habitat restoration plans for the navigation pools in the St. Paul District. The plan for pool 3 has yet to be developed. It was decided that the best approach would be wait until the FWWG develops a habitat restoration plan for pool 3. If that plan includes island restoration in North and Sturgeon Lakes, the resource management agencies, the Prairie Island Indian Community and the District can then look at the best method for accomplishing this task.

f. Diamond Island – At the request of the Minnesota DNR, the District has developed a plan for restoration of the secondary channel behind Diamond Island. The Minnesota DNR will review this plan and provide comments to the District. If an acceptable plan can be agreed upon, we will need to address the question of how to implement the solution.

g. Head of Lake Pepin/Lake Pepin – Concerns have been expressed over the resuspension of fine sediments by commercial tow traffic, particularly at the head of Lake Pepin and in the lower portions of the defined navigation channel in upper pool 4. With respect to the lower portions of the defined navigation channel in upper pool 4 there is not much that can be done to avoid or minimize this problem. This is an active delta aggradation area and there are always going to be conditions at the margin of the delta where tows will pass over relatively shallow water and resuspend sediments.

It would be desirable to buoy a navigation channel down to at least river mile 788, and possibly throughout the entire length of Lake Pepin. Some initial coordination with the towing industry indicates that a single navigation channel through Lake Pepin 600-1,000 feet wide would be acceptable. With respect to this study, we will recommend that this matter be referred to the Navigation Work Group for further consideration.

h. Wing Dam Notching – The District has developed a plan to notch 21 wing dams in pool 3 for improving local bathymetric diversity and fish habitat. This total includes the two wing dams that would be notched as part of the Big River wing dam restoration feature discussed above. The plan was discussed and no modifications were made to the plan.

The District will be conducting bathymetric surveys in the spring of 2001 to evaluate the effects of wing dam notchings in pool 5. Eventually we hope to develop the capability to predict the types and dimensions of scour holes that would be formed by various wing dam notching designs.

i. Morgans Coulee/Coulters Island – The District currently dredges in the Morgans Coulee/Coulters Island reach about 6 out of every 10 years. This material must be mechanically dredged and taken to the Corps Island temporary placement site. A design has been developed to construct rock structures in three side channels to retain more flow in the main channel for the purpose of shifting dredging requirements from the Morgan's Coulee/Coulters Island dredge cuts to the Diamond Bluff dredge cut. This would reduce dredging costs by decreasing the amount of mechanical dredging and increasing the amount of hydraulic dredging in this reach. The rock structures include a partial closure at RM 801.7 (Brewers Lake Inlet), a partial closure at RM 802.3 (Coulters Island inlet), and riffle structures at RM 802.9 (Miley Run).

The design would moderately reduce flow into Miley Run, substantially reduce flow into Brewer Lake, and substantially increase flow into the downstream Sturgeon Lake inlet. The effects on flows entering the Coulters Island inlet would be relatively minor. We currently estimate that the increased main channel velocities would shift about 50 percent of the Coulters Island dredging down river to the Diamond Island area.

The primary concern voiced by the agency representatives was the potential effects on Buffalo Slough, the channel connecting North and Sturgeon Lakes. This area has a diversity of depths, a hard bottom, and is a popular fishing area. This concern would primarily be associated with the reduction of flows through the Brewer Lake inlet.

We indicated that we still were evaluating these features and that it appeared at this time that the cost of the features was going to be far beyond what could be justified by the potential channel maintenance savings.

3. The two matters outstanding at the end of the meeting were (1) the Minnesota DNR review of the Diamond Island design and (2) the environmental concerns associated with the Morgans Coulee/Coulters Island proposal if the District pursues it further.

Gary Palesh
Project Manager

Palesh, Gary D MVP

From:	Scot Johnson [scot.johnson@dnr.state.mn.us]
Sent:	Tuesday, November 14, 2000 10:55 AM
To:	Palesh, Gary D
Cc:	Bill Huber; Daniel Dieterman; Diana Regenscheid; Jack Enblom; Mike Davis; Mike Tenney; Pat Lynch; Steve Johnson-WAT; Tim Schlagenhaft; Wayne Barstad; Walter Popp; Gary_Wege@fws.gov; BenjaG@mail01.dnr.state.wi.us; judy.mader@pca.state.mn.us
Subject:	Follow-Up CMP Pool 3/4 meeting/mailings

Hi Gary,

Here are MDNR's additional thoughts on the issues raised at the last meeting:

1. Carter Slough - We are pleased with the plan and would like to see this structure built sooner rather than later. I recall that Ducks Unlimited wrote a letter in support of this structure under the Section 205 program. Please consult with Tim Yeager and see if construction of this structure can be moved up in priority.

2. North and Sturgeon Lake Islands - We have no specific proposal to suggest.

3. Diamond Island Secondary Channel - There is limited interest within the DNR for the proposed project at this time. To my knowledge, Fisheries and Wildlife have not yet talked with the Red Wing Wildlife League in regards to the detailed plan sheet showing the vanes that will protect from a breakout onto their property. Unless Fisheries, Eco Services and/or Wildlife decide to champion this project it will not be pursued or supported by the DNR.

4. Wing Dams - We have forwarded the MDNR mussel survey information to you and Dennis Anderson already. Please review the proposed plan against the mussel data. We have not yet identified a wing dam field for conversion to a submerged rock/cobble substrate.

5. Lake Pepin Navigation - Your proposed language is fine except we still feel the GPS or Line of Sight navigation aids could be used instead of black and green cans. Please include language that will direct the Navigation Work Group to look at alternative means for marking a channel throughout the length of Lake Pepin.

6. Lake Pepin Sediment Load - We have spoken with Jon Hendrickson in regards to this issue and would like to see the CMP address in writing the feasibility (pros and cons) of creating a sediment trap upstream of Lake Pepin (possibly before the Main and Wisconsin Channel split) to prolong the life of Lake Pepin. We know from recent studies that the sedimentation rate is now 11 times greater than pre-settlement rates. It is projected that the upper end of Lake Pepin will be filled within 100 years and the entire Lake in 340 years.

Thanks for the opportunity to provide our input into the CMP and for your efforts in development of this plan.

Scot Johnson
Mississippi River Hydrologist
scot.johnson@dnr.state.mn.us
651/345-5601
651/345-3975 fax

WISCONSIN
DEPT. OF NATURAL RESOURCES

State of Wisconsin \ DEPARTMENT OF NATURAL RESOURCES

Tommy G. Thompson, Governor
George E. Meyer, Secretary
Scott A. Humrickhouse, Regional Director

3550 Mormon Coulee Rd
La Crosse, Wisconsin 54601
Telephone 608-785-9000
FAX 608-785-9990

November 16, 2000

Mr. Gary Palesh
USACE – St. Paul District
190 Fifth Street East
St. Paul, MN 55101-

RE: Pool 3 and Upper Pool 4 Channel Management Study

Dear Mr. Palesh:

I have looked over the most recent information handed out on October 11, 2000 and I have just few comments to forward to you.

In the proposal for Big River wingdam work it is unclear whether or not the wingdam structures will be raised above original grade. The report clearly states that the wing dams would not be restored beyond their original length however it never mentions original elevation. If this work follows original design specification then a WDNR permit is not needed.

At this point we do not foresee any problem with investigating the use of a structure at the head end of Diamond Island but a Wisconsin permit will be required. A detailed hydraulic analysis will be necessary to determine if the structure will accomplish the goals of the project.

On October 11, 2000 we had a long discussion about Lake Pepin and marking the channel at the head end and through the lake. At a minimum we would like to have the channel marked from river mile 776 upstream to the current channel markers. If we can work with the Coast Guard and the industry to improve the movement through the body of the lake that would also be desirable.

Finally, we understand that Mike Davis has provided the mussel data for Pool 3 and it may preclude some wingdams notching. Prior to any final decisions for wingdam notching we should have a discussion with fisheries experts present to determine if wingdam notching might be beneficial.

Thank you, for your hard work on this project.

Sincerely,

Gretchen L. Benjamin
Mississippi River Planner

C Scot Johnson, MDNR, Lake City, MN
Judy Mader, MPCA, St. Paul, MN
Gary Wege, USFWS, Bloomington, MN
Craig Wilt, Prairie Island Community
Brian Brecka, WDNR, Alma, WI

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Twin Cities Field Office
4101 East 80th Street
Bloomington, Minnesota 55425-1665

DEC 13 2000

Mr. Robert J. Whiting
Chief, Environmental and Economic
Analysis Branch
St. Paul District, U.S. Army Corps of Engineers
Army Corps of Engineers Centre
190 Fifth Street East
St. Paul, Minnesota 55101-1638

Dear Mr. Whiting:

This concerns your November 30, 2000, letter requesting U.S. Fish and Wildlife Service comments on potential impacts to federally endangered or threatened species from several proposed construction activities associated with the Channel Management Study for Pool 3 and Upper Pool 4 of the Upper Mississippi River.

Based on information contained in your above referenced letter and the nature of the proposed projects, their location, and the habitat requirements of the federally threatened bald eagle (Haliaeetus leucocephalus) and endangered Higgins' eye pearly mussel (Lampsilis higginsi), we concur with your determination that the proposed projects are not likely to adversely affect federally listed threatened or endangered species. Should these projects be modified or new information indicates that listed species may be affected, consultation with this office should be reinitiated.

These comments have been prepared under the authority of and in accordance with provisions of the Endangered Species Act of 1973, as amended. Comments with respect to the Fish and Wildlife Coordination Act will be provided at the appropriate stage of planning. We appreciate the opportunity to offer our comments on this project.

Sincerely,

Russell D. Peterson

Russell D. Peterson
Field Supervisor

cc: Wisconsin Department of Natural Resources, LaCrosse, Wisconsin
Minnesota Department of Natural Resources, Lake City, Minnesota

DEPARTMENT OF NATURAL RESOURCES

STATE OF MINNESOTA
OFFICE MEMORANDUM

DATE: January 31, 2001

TO: Gary Palesh, Corps of Engineers, St. Paul

FROM: Scot Johnson, DNR Waters, Lake City
scot.johnson@dnr.state.mn.us

SUBJECT: Comments on the Preliminary Draft of the Pool 3/Upper 4 CMP DPR

Thanks for the opportunity to look over the preliminary draft DPR. As you requested, I have looked over Chapters 8 and 9 and have coordinated with other DNR staff. Here are our comments:

1 8.1.2.3. Emergent Rock Dike - A Minnesota Protected Waters Permit would be required for this structure. Prior to issuance of the permit, appropriate compensation measures for the loss of aquatic habitat must be agreed to by all parties. Also, the project would trigger the need for a Minnesota EAW. A federal EA noticed in the EQB monitor would likely suffice.

2 8.2.1. Lock and Dam 2 Flats Island - The island design details are new. The width, height and protection measures for this potential island seem excessive and will likely need to be reviewed and agreed upon prior to any future implementation. As discussed earlier, the MDNR's preference is to allow the natural island building process that is occurring in this area to take its course.

3 8.2.2. L/D Lower Approach Cut - It is more likely that the material would go to the Koch site. I do not believe the Hastings Harbor site has been used and it will not likely be used as long as there are alternative sites.

4 8.4. Mud Hen Lakes - The submerged plant community is already largely gone. Mud Hen Lakes contain an extensive fringe of emergent vegetation but it is thinning and receding.

5 8.10.1. Wing Dam Rubble Bar - We suggest the Corps evaluate the wing dams between river miles 809.6 and 810.0 along the right descending bank for the formation of a rubble bar.

6 8.11.2.1. Diamond Island - We would like to propose an alternative design for your consideration that includes a stepped approach augmented by available materials. The following proposal would greatly reduce costs and include modification to two 9-Foot Channel Project training structures.

1. Notch/remove the existing federal closing dam that currently runs across the secondary channel to facilitate more flow and bed scour. (This closing dam is not shown on any of the attached maps but should be shown). Access dredging could be minimized by working during higher water levels and by approaching the closing dam from the downstream side.

2. Material from the closing dam would then be used to help build a low, temporary, notched closing structure across the narrowest reach of the upper end of the secondary channel. The top elevation would be 669, the notch 10 feet wide with a 3 foot deep v-

6 notch (666) that is buoyed/marked. This would redirect Cannon and Vermillion River flow during low flow conditions down the secondary channel and help scour the bed of the channel. Since the temporary structure would not redirect high flows, there would be a relatively small change in hydraulics through the channel during a high flow event and rock vanes would not likely be more necessary during/after the project.

3. Over a period of time, the redirected flow will have scoured the channel bed and the temporary dam would be removed. The upstream wing dam on the Main Channel would then be notched in such a way as to redirect Mississippi River flow down the secondary channel to help perpetuate the channel. Wing dam and temporary closing structure rock materials could then be used to build vanes or shore protection along either the secondary channel or the main channel as needed.

We believe this proposal represents a low cost alternative that would adequately address all parties concerns. Please ask your hydraulic engineers to evaluate this proposal.

7 8.12. Wisconsin Channel - The closing dam was rehabilitated in the early 1990s not in the late 1980s. Since rehabilitation, depths in the Wisconsin Channel appear to have been reduced and more flow is being captured by cuts leading to Mud Lake and Dead Slough Lake. What was the percent reduction in discharge after the rehabilitation of the closing structure? Should we rethink the notch size?

8 8.15.2.2.4. Lake Pepin sedimentation rates - Recently published studies show conclusively that sedimentation rates have increased markedly since European settlement. Early on in the CMP planning process, we asked about the possibility of enhancing the topographic/bathymetric diversity of the Lake Pepin delta area by using dredged materials to build islands. Would very low islands or sub-aqueous mounds in the Bay City flats area be a feasible option to provide better substrate for rooted aquatic plants and benthic invertebrates?

9 Table 8.9 Recommendations - Once we have the alternatives all squared away, we suggest you replace "No action" with " No action under Operation and Maintenance Authorities"

10 9.1 In my estimation, Carter Slough access dredging material would more likely go to Corps Island.

11 9.2 Years for completing the work are incorrect.

Thanks once again for the opportunity to review the preliminary draft of the DPR. If you have questions or need clarification please give me a call at 651/345-5601.

Responses to Minnesota DNR Comments dated January 31, 2001

1. Comment noted. No response required.

2. The island details are the same as those presented at the 11 October 2000 coordination meeting. If this feature is ever pursued in the future, additional evaluation and design work would be required to develop a plan acceptable to everyone involved.

3. This has been noted in the referenced paragraph.

4. The referenced discussion has been revised to reflect this.

5. We looked at wing dams 809.7, 809.8 and 809.9 and there appears to be good bathymetric diversity around these structures, making it likely they provide good fish habitat in their present condition. However, we are proposing to remove a 100-foot segment of wing dam 809.5 as a test of this habitat restoration method (see revised section 8.10).

6. We have looked at the proposal and have the following observations.

a. The vanes for shore protection were a conservative design added due to the concerns expressed by the Red Wing Wildlife Protection League about inducing bank erosion and breakout flows onto their property. The vanes could be eliminated from the design but the project would need to be monitored for bank erosion.

b. Notching the closing dam by itself would little or no effect on opening up the back channel because of the accumulated sediment now present.

c. Constructing a closing dam to elevation 669.0 would be insufficient to generate the type of changes desired. The design philosophy of the closing dam is keep the Mississippi River out much of the time and allow the Cannon/Vermillion River flows to affect the geomorphic change in the back channel. If anything, the design elevation we considered of 672.0 is somewhat on the low side because the 1.5-year flood event has an elevation of about 675.0 in this reach. A top elevation of 669.0 just won't have much of an effect on hydraulic and geomorphic conditions.

We have added information to this effect to the discussion of this item in Section 8.11. The bottom line still remains that if someone is interested in pursuing this project under one of the available authorities, the District would consider it further.

7. A review indicates the closing dam was repaired in 1992. This has been corrected in the report. At the time of construction, the District did an analysis and found that for the 10-year, 7-day low flow discharge of 3,190 cfs, that the reduction in conveyance due to the repair was about 7%. We estimate the reduction in discharge to no more than 10% for the low flow condition. For higher flow conditions, especially those approaching the

bank full condition, which transports most of the sediment, the reductions in conveyance area and discharge would be even less significant. We don't believe any sediment deposition in the Wisconsin Channel or changes in flow to Mudhen and Dead Slough Lake can be attributed to the closing dam repair.

8. A discussion concerning this matter has been added to section 8.15. The next time the Head of Lake Pepin dredge cut requires dredging, the St. Paul District would be willing to considered using dredged material for the construction of low islands or underwater mounds.

9. The table has been modified to reflect this.

10. Corps Islands has been added as a potential placement site for the material.

11. This has been corrected.

Palesh, Gary D MVP

From: Mader, Judy [judy.mader@pca.state.mn.us]
Sent: Thursday, February 01, 2001 12:47 PM
To: 'Palesh, Gary [COE]'
Cc: 'Benjamin, Gretchen [WI DNR]'; 'Johnson, Scot [DNR]'; 'Wege, Gary [USFWS]'; 'Machajewski, Paul [COE]'
Subject: (belated) comments on Preliminary Draft DPR/EA Pool3 / Upper 4

Gary:

I know that my comments are a day late, but I hope to make up for that by providing comments on the bulk of the document.

Comments on the COE's Preliminary Draft Definite Project Report / Environmental Assessment Pool 4 / Upper Pool 4 Channel Management Study

1 The Minnesota Pollution Control Agency (MPCA or Agency) did not review the Appendices, which included the 404(b)(1) evaluation. However, since the Agency did review the main section of the Preliminary Draft, the COE may consider the comments below as the Agency's comments for the public review draft, to be distributed at the end of February 2001, barring significant changes to the selected plan.

2 Please add to the last sentence of the first paragraph on page 4-7 "and the long "life" of some of the contaminants" at the end of the sentence as that is another reason some contaminant levels remain high.

3 The COE has identified the possible need for access dredging for some of the features chosen. The MPCA would like to point out the likely need for sediment analyses at all such sites given: a) the absence of or infrequent dredging in those areas; and b) the long "life" of many contaminants of concern. (The COE had already identified the need for sediment analyses, on page 8-3, if dredging was needed prior to the construction of a 600-foot rock dike extension of the lower guard wall at Lock and Dam 2.)

4 Regarding the evaluation of channel marking options for Lake Pepin, on pages 8-31 and 8-32, the MPCA believes that the COE should not have to conduct a detailed analysis of the feasibility of channel marking via GPS coordinates. Rather, the MPCA believes that the COE should map out the GPS coordinates as soon as funding becomes available and should publish that information so those watercraft equipped with that technology can start using the information immediately. (Since the COE has the mandate to maintain the channel for navigation, the MPCA would argue that this includes providing the GPS coordinates through Lake Pepin as well as maintaining the nine-foot channel elsewhere via dredging.)

5 Under the restoration of wing dams on page 9-2, the construction date is given as 1999 or 2000. Since both of those years have passed, that should be updated so those not familiar with the COE and their operations don't incorrectly assume that the work has been done already.

6 In the first paragraph in section 10.2.4 the COE makes the statement that 'the material to be dredged is relatively clean, ...'. The COE, however, gives no supporting information for that statement.

The only other comments that I had on the Preliminary Draft were grammatical and/or formatting suggestions, none of which are critical for the completion of the public review draft.

Judy Mader
MPCA
phone: (651) 296-7315
FAX: (651) 297-8683
e-mail: judy.mader@pca.state.mn.us

Responses to Minnesota PCA Comments dated February 1, 2001

1. No response required.

2. The requested change has been made.

3. A determination will be made at a later date whether or not testing is required, once we have a better idea of the quantity of material to be dredged and we have had a chance to make a visual inspection of the material. That determination will be coordinated with the appropriate agencies, the Minnesota Pollution Control Agency included.

4. The sentence regarding the studying the feasibility of marking the channel using GPS coordinates has been deleted from page 8-32. We have recently completed a GPS marking of all of the bouys on Lake Pepin for new navigation charts. However, this does not address the unmarked portion of Lake Pepin. Additional study is not needed to determine whether or not marking a channel using GPS technology is feasible. The additional study is necessary for making the decision whether the channel in Lake Pepin needs to be marked, and if so, where. We believe this is a subject best addressed by the Navigation Work Group.

With regards to the Corps's responsibility re: providing for navigation, it is the Corps responsibility to provide a safe channel with adequate depths for navigation. It is the Coast Guard's responsibility to mark the channel. Lake Pepin is a unique situation where there is more than adequate depth and width for commercial navigation. The Corps does not need to do anything to allow commercial traffic to pass through Lake Pepin. The Coast Guard has not marked a specific channel in the lake because in the past there has been a need identified for a marked channel. This study has identified a potential concern and the Coast Guard, working with the Navigation Work Group, will have to determine if the concern is substantial enough to warrant marking a channel in Lake Pepin.

5. The dates have been corrected.

6. The wording of the referenced section has been revised to indicate the basis for believing the material is clean.

State of Wisconsin \ DEPARTMENT OF NATURAL RESOURCES

WISCONSIN
DEPT. OF NATURAL RESOURCES

Scott McCallum, Governor
Darrell Bazzell, Secretary
Scott A. Humrickhouse, Regional Director

3550 Mormon Coulee Rd
La Crosse, Wisconsin 54601
Telephone 608-785-9000
FAX 608-785-9990

February 6, 2001

Mr. Gary Palesh
USACE – St. Paul District
190 Fifth Street East
St. Paul, MN 55101- 1638

RE: Pool 3/Upper 4 Channel Management Study Report

Dear Mr. Palesh:

This letter will provide comments from the Mississippi Lower St. Croix Team of Wisconsin Department of Natural Resources for the Pool 3/Upper 4 Channel Management Study.

General Comments

1 Overall we are pleased with the results for the Pool 3/ Upper 4 Channel Management Study. Especially noteworthy is the recommendation to notch 19 wingdams. This shows positive effort toward creating environmental benefits within the constraints of channel management. I was also encouraged with the thorough evaluation of the dredging problem at Coulter's Island and Morgan Coulee. I assumed there would be a structural modification recommendation but due to economic and environment reasons a solution could not be found. This demonstrates the complete evaluation lead to an objective decision.

2 Based on the information in section 8.6, the repair of the "Big River" wingdams will not require a permit from the Wisconsin Department of Natural Resources. In the report the work would include only the restoration of existing wingdams and therefore does not require a permit. If changes occur during plans and specifications that would alter the height or length of the structures, a Wisconsin permit will be necessary.

Specific Comments

In section 2.3 Water Quality, John Sullivan has provided a number of editorial comments that I will forward for your consideration.

3 • On page 2-3, first paragraph, last sentence, the sentence would read better if it was changed to, "Water and sediment… but, remain **more degraded** than found in the St. Paul… Pepin.
4 • Second paragraph, third sentence, should read, "Because of its turbulent nature **and large flow** the river … loading.
5 • Second paragraph last sentence, should be changed to, "The high suspended **sediment** load from the Minnesota River greatly influences suspended solids **concentration** levels in this reach.
6 • Third paragraph may need some clarification. I will send you John's margin comments for comparison.

7 • In paragraph four, the Hinkro and Moody study and Rostad study referenced are not from the main channel and may be an inappropriate comparison.

8 • Fifth paragraph, third sentence, "Because of the nutrient enrichment **and longer hydraulic retention time,** Lake Pepin experiences … dissolved oxygen.

9 • Fifth paragraph, fourth sentence, what is the reference for this statement.

10 In section 8.15, sediment resuspension at the upper end of Lake Pepin is a serious concern for the Wisconsin Department of Natural Resources. Of the four alternatives listed under this section we would strongly advocate for alternative b. at a minimum and we do not necessarily believe that marking the entire lake should be completely disregarded.

11 Two small editorial errors should be corrected. On page 8-9, under 8.4.1, "In addition, Minnesota Depart should be changed to Minnesota Department. Secondly, on page 8-30, second paragraph, first sentence, the "for" after contaminants should be eliminated.

Thank you, for the opportunity to work on this channel management plan and comment on this report.

Sincerely,

Gretchen L. Benjamin
Mississippi River Planner

C Scot Johnson, MNDNR, Lake City, MN
Gary Wege, USFWS, Bloomington, MN
Judy Mader, MPCA, St. Paul, MN

Responses to Wisconsin DNR Comments dated February 6, 2001

1. No response required.

2. No response required.

3. The recommended change has been made.

4. The recommended change has been made.

5. The recommended change has been made.

6. No response required.

7. The referenced paragraph is intended to be a general discussion of the presence of contaminants in the study reach, not just the main channel which was the subject of the previous paragraph.

8. The recommended change has been made.

9. A reference has been added.

10. This view has been added to the referenced section.

11. The errors have been corrected.

DEPARTMENT OF THE ARMY
ST. PAUL DISTRICT, CORPS OF ENGINEERS
ARMY CORPS OF ENGINEERS CENTRE
190 FIFTH STREET EAST
ST. PAUL, MN 55101-1638

February 13, 2001

REPLY TO
ATTENTION OF

Environmental and Economic Analysis Branch
Planning, Programs and Project Management Division

Mr. Chip Brown
State Compliance Coordinator
Division of Historic Preservation
State Historical Society of Wisconsin
816 State Street
Madison, Wisconsin 53706

Dear Mr. Brown:

The St. Paul District, Corps of Engineers, is planning a channel management project for Pool 3 and upper Pool 4 of the Mississippi River. This portion of the river runs from Lock and Dam 2 at Hastings, Minnesota, to the head of Lake Pepin. This includes Pierce County, Wisconsin, and Washington, Dakota and Goodhue Counties in Minnesota.

The features of this channel management project are described below and are marked on the accompanying maps.

Lower approach to Lock and Dam 2. The project proposes further study of a proposal to build a 600-foot extension of the lower guard wall (in the form of a rock dike) to correct a lateral current problem just below Lock and Dam 2 at Hastings. Lock and Dam 2 was built in advance of the authorization of the nine-foot channel project that built Locks and Dams 3 through 26. It is considered not eligible for the National Register of Historic Places.

Carter Slough. Construction of a new spot dike at Carter Slough (river mile 807.3) is recommended to prevent habitat degradation occurring as a result of bypassing of the existing spot dike. A historic farmsite (21 DK 58) is known for the downstream bank of Carter Slough. The placement of a rock dike across Carter Slough has little or no potential to adversely affect the site. Effects will be minimized by avoiding any staging activities in the site area, and by minimizing any bank preparation necessary to tie in the rock dike.

Big River. Restoration of four wing dams on the Wisconsin side of the navigation channel at river mile 805 is recommended to reduce shoaling in this area. The purpose is to make a bend in the navigation channel in this area more navigable and to reduce the potential for future dredging requirements.

Wing Dam Notching. Notching 19 wing dams is recommended to provide fish habitat improvements. The notches are designed to promote the formation of scour holes and channels to improve bathymetric diversity in relatively monotypic main channel border areas. Nine of the 19 wing dams are on the Wisconsin side of the river, and the remaining 10 are on the Minnesota side.

The only historic properties identified within the project area that may be affected are the wing dams themselves. The project proposes to notch 19 wing dams and restore 4 wing dams (10 in Minnesota and 13 in Wisconsin). In an earlier channel management project for Pool 5 (SHSW #99-0161/BF), we presented an argument that the wing dams, closing dams and shore protection built in the Mississippi River in the St. Paul District under the 4½-foot and 6-foot channel projects are eligible for the National Register of Historic Places under Criteria A and B (letter of July 2, 1999 to the MN SHPO, copy enclosed).

We recognize that altering the wing dams will affect these historic resources. Given that the St. Paul District has and will have projects that affect channel constriction works throughout its portion of the upper river, we proposed for the Pool 5 channel management project that we develop a Programmatic Agreement covering how to meet the historic preservation, navigation, and environmental needs concerning wing dams. In subsequent exchanges with the MN SHPO office (letter of August 23, 1999 from the MN SHPO, copy enclosed), we agreed that further documentation is needed concerning the wing dams and their history, especially an inventory of current condition and function and further discussion of significance and integrity. We are currently preparing that documentation, with the aid of a complete GIS database of the St. Paul District wing and closing dams.

The work proposed in the current Pool 3-upper Pool 4 channel management project will not destroy any wing dams. The notches, allowing more water to flow through part of the mid-section of the dam, average 20 feet in width in an average wing dam length

of about 100 feet. The wing dam notching and restoration (to be accomplished by adding rock), which have the goals of improving fish habitat and improving navigation, continue the association of the wing dams with channel management. We believe that these modifications will have a minor effect on the overall system of the historic channel confinement works that is now being further evaluated.

We would be grateful for your review of this project. Please call Sissel Johannessen (651 290-5263) with comments or questions.

Sincerely,

Robert J. Whiting
Chief, Environmental and Economic Analysis Branch

Enclosures
(4 maps, 2 letters)

DEPARTMENT OF THE ARMY
ST. PAUL DISTRICT, CORPS OF ENGINEERS
ARMY CORPS OF ENGINEERS CENTRE
190 FIFTH STREET EAST
ST. PAUL, MN 55101-1638

February 13, 2001

REPLY TO
ATTENTION OF

Environmental and Economic Analysis Branch
Planning, Programs and Project Management Division

Mr. Dennis A. Gimmestad
Government Review & Compliance Officer
State Historic Preservation Office
Minnesota Historical Society
345 Kellogg Boulevard West
St. Paul, Minnesota 55102-1906

Dear Mr. Gimmestad:

The St. Paul District, Corps of Engineers, is planning a channel management project for Pool 3 and upper Pool 4 of the Mississippi River. This portion of the river runs from Lock and Dam 2 at Hastings, Minnesota, to the head of Lake Pepin. This includes Pierce County, Wisconsin, and Washington, Dakota and Goodhue Counties in Minnesota.

The features of this channel management project are described below and are marked on the accompanying maps.

Lower approach to Lock and Dam 2. The project proposes further study of a proposal to build a 600-foot extension of the lower guard wall (in the form of a rock dike) to correct a lateral current problem just below Lock and Dam 2 at Hastings. Lock and Dam 2 was built in advance of the authorization of the nine-foot channel project that built Locks and Dams 3 through 26. It is considered not eligible for the National Register of Historic Places.

Carter Slough. Construction of a new spot dike at Carter Slough (river mile 807.3) is recommended to prevent habitat degradation occurring as a result of bypassing of the existing spot dike. A historic farmsite (21 DK 58) is known for the downstream bank of Carter Slough. The placement of a rock dike across Carter Slough has little or no potential to adversely affect the site. Effects will be minimized by avoiding any staging activities in the site area, and by minimizing any bank preparation necessary to tie in the rock dike.

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Wing Dam Notching. Notching 19 wing dams is recommended to provide fish habitat improvements. The notches are designed to promote the formation of scour holes and channels to improve bathymetric diversity in relatively monotypic main channel border areas. Nine of the 19 wing dams are on the Wisconsin side of the river, and the remaining 10 are on the Minnesota side.

The only historic properties identified within the project area that may be affected are the wing dams themselves. The project proposes to notch 19 wing dams and restore 4 wing dams (10 in Minnesota and 13 in Wisconsin). In an earlier channel management project for Pool 5 (SHPO # 99-1585), we presented an argument that the wing dams, closing dams and shore protection built in the Mississippi River in the St. Paul District under the 4½-foot and 6-foot channel projects are eligible for the National Register of Historic Places under Criteria A and B (letter of July 2, 1999).

We recognize that altering the wing dams will affect these historic resources. Given that the St. Paul District has and will have projects that affect channel constriction works throughout its portion of the upper river, we proposed for the Pool 5 channel management project that we develop a Programmatic Agreement covering how to meet the historic preservation, navigation, and environmental needs concerning wing dams. In a further letter (yours of August 23, 1999) and subsequent conversations with your office, we agreed that further documentation is needed concerning the wing dams and their history, especially an inventory of current condition and function and further discussion of significance and integrity. We are currently preparing that documentation, with the aid of a complete GIS database of the St. Paul District wing and closing dams. After evaluation is completed, if the constriction works do prove eligible, we can proceed with a more informed assessment of effects and a Programmatic Agreement concerning effects and mitigative actions.

The work proposed in the current Pool 3-upper Pool 4 channel management project will not destroy any wing dams. The

notches, allowing more water to flow through part of the mid-section of the dam, average 20 feet in width in an average wing dam length of about 100 feet. The wing dam notching and restoration (to be accomplished by adding rock), which have the goals of improving fish habitat and improving navigation, continue the association of the wing dams with channel management. We believe that these modifications will have a minor effect on the overall system of the historic channel confinement works that is now being further evaluated.

We would be grateful for your review of this project. Please call Sissel Johannessen (651 290-5263) with comments or questions.

Sincerely,

Robert J. Whiting

Enclosures

Robert J. Whiting
Chief, Environmental and Economic
Analysis Branch

DEPARTMENT OF THE ARMY
ST. PAUL DISTRICT, CORPS OF ENGINEERS
ARMY CORPS OF ENGINEERS CENTRE
190 FIFTH STREET EAST
ST. PAUL, MN 55101-1638

MAR 2 2001

REPLY TO
ATTENTION OF

Project Management Branch
Planning, Programs, and Project Management Division

Dear Interested Parties:

Enclosed for your information, review, and comment is the draft Definite Project Report/Environmental Assessment for the Pool 3/Upper Pool 4 Channel Management Study, Upper Mississippi River. The report contains an integrated environmental assessment, a draft Finding of No Significant Impact (FONSI), and a Section 404(b)(1) evaluation. We are distributing this report to concerned agencies, local units of government, interested groups, and individuals. If you have any comments on the report or environmental assessment, please provide them within 30 days of the date of this letter.

The Section 404(b)(1) evaluation is being distributed as part of this report in lieu of a separate Section 404 public notice. Anyone may request a public hearing on this project. The request must be submitted in writing within 15 working days of the date of this letter. Interested parties are also invited to submit to this office written facts, arguments, or objections to this project within 30 days of the date of this letter. These statements should clearly state the interest that the project would affect and how the project would affect that interest. All statements, oral or written, will become part of the official project file and will be available for public examination.

Questions concerning the Pool 3/Upper Pool 4 Channel Management Study should be directed to Mr. Gary Palesh, Project Manager, at (651) 290-5282 or at gary.d.palesh@mvp02.usace.army.mil.

Please address all correspondence to the St. Paul District, Corps of Engineers, ATTN: CEMVP-PM-A, 190 Fifth Street East, St. Paul, Minnesota 55101-1638.

Sincerely,

Charles E. Crist

Charles E. Crist
Deputy for Programs and
Project Management

Enclosure

DEPARTMENT OF THE ARMY
ST. PAUL DISTRICT, CORPS OF ENGINEERS
ARMY CORPS OF ENGINEERS CENTRE
190 FIFTH STREET EAST
ST. PAUL, MN 55101-1638
MAR 2 2001

REPLY TO
ATTENTION OF

Project Management Branch
Planning, Programs, and Project Management Division

Dear River Resources Forum Member:

Enclosed for your information, review, and comment is the draft Definite Project Report/Environmental Assessment for the Pool 3/Upper Pool 4 Channel Management Study, Upper Mississippi River. The report contains an integrated environmental assessment, a draft Finding of No Significant Impact (FONSI), and a Section 404(b)(1) evaluation. If you have any comments on the report or environmental assessment, please provide them within 30 days of the date of this letter.

The Section 404(b)(1) evaluation is being distributed as part of the report in lieu of a separate Section 404 public notice. Anyone may request a public hearing on this project. The request must be submitted in writing within 15 working days of the date of this letter. Interested parties are also invited to submit to this office written facts, arguments, or objections to this project within 30 days of the date of this letter. These statements should clearly state the interest that the project would affect and how the project would affect that interest. All statements, oral or written, will become part of the official project file and will be available for public examination.

This is also to inform you that we will be asking for River Resources Forum endorsement of this study and the recommendations contained in the report at the April 2001 meeting of the Forum. Of primary interest are the recommendations for construction of the new Carter Slough spot dike, the rehabilitation of 4 wing dams in the Big River area, and the notching/partial removal of 19 wing dams for fish habitat enhancement. We are seeking endorsement at the April meeting so that we may proceed towards construction of these features during the 2001 open water season as our capabilities allow.

Questions concerning the Pool 3/Upper Pool 4 Channel Management Study should be directed to Mr. Gary Palesh, Project Manager, at (651) 290-5282 or at gary.d.palesh@mvp02.usace.army.mil.

Please address all correspondence to the St. Paul District, Corps of Engineers, ATTN: CEMVP-PM-A, 190 Fifth Street East, St. Paul, Minnesota 55101-1638.

Sincerely,

Charles E. Crist
Charles E. Crist
Deputy for Programs and
Project Management

Enclosure

USDA NRCS
Natural Resources Conservation Service

United States Department of Agriculture
Natural Resources Conservation Service

State Office
6515 Watts Road, Suite 200
Madison, Wisconsin 53719-2726

Phone (608) 276-8732
Fax (608) 276-5890

April 4, 2001

Mr. Charles E. Crist, Deputy
US Army Corps of Engineers
ATTN: CEMVP-PM-A
190 Fifth Street East
St. Paul, Minnesota 55101-1638

Dear Mr. Crist:

This letter is in response to our review of the draft "Definite Project Report/Environmental Assessment for the Pool 3/Upper Pool 4 Channel Management Study, Upper Mississippi River." Thank you for the opportunity to review this document.

Our agency found the project to have no significant impacts on agriculture land. Therefore, we have no further comment on the project.

If you have any questions or need any additional information pertaining to this review, please call Sherrie Zenk-Reed at (715) 799-3896.

Sincerely,

Patricia S. Leavenworth

PATRICIA S. LEAVENWORTH
State Conservationist

cc:
Sherrie Zenk-Reed, Soil Conservationist, NRCS, Shawano, Wisconsin

Minnesota Department of Natural Resources

Lake City Area Office
1801 South Oak Street
Lake City, Minnesota 55041

651/345-5601

April 5, 2001

Mr. Gary Palesh, Technical Manager
U.S. Army Corps of Engineers, St. Paul District
190 Fifth Street East
St. Paul, Minnesota 55101-1638

Dear Mr. Palesh:

Re: Pool 3/Upper Pool 4 Channel Management Plan - draft Definite Project Report

The draft Definite Project Report for the Pool 3/Upper Pool 4 Channel Management Plan was circulated through the Department of Natural Resources' (DNR) St. Paul Central, Metro, Rochester and Lake City Area Offices for review and comment. DNR staff have completed their review of the draft plan and are generally pleased with the document's findings and the proposed actions.

DNR staff look forward to future collaboration with the Corps through the On-Site Inspection Team on the notching of existing wing dams and the rebuilding of the Carter Slough closing structure. For those project features within Minnesota, a Protected Waters Permit is required.

In regards to the Diamond Island secondary channel, it is our opinion that the federal 9-Foot Channel Project's lower closing structure and upper wing dam contributed to the accretion of sediment in the secondary channel. Restoration of fish and wildlife habitat within the secondary channel would likely require the modification of one, or both, of these two federal structures. DNR staff believe it would be appropriate for the Corps to spend 9-Foot Channel Project Operation and Maintenance dollars to restore habitat in this secondary channel and look forward to working with Corps staff on possible alternative designs.

Thank you for the opportunity to comment. Please call if you have questions or concerns regarding our comments and recommendations.

Sincerely,

Scot Johnson

Scot Johnson
Mississippi River Hydrologist

cc.	Jim Cooper, Waters, Rochester	Bill Huber, Waters, Lake City
	Tim Schlagenhaft, Fisheries, Lake City	Dan Dieterman, Fisheries, Lake City
	Mike Davis, Eco Services, Lake City	Mike Tenney, Wildlife, Rochester
	Diana Regenscheid, Wildlife, Shakopee	Walt Popp, Eco Services, Lake City
	Steve Johnson, Waters, St. Paul	Jack Enblom, Eco Services, St. Paul
	Wayne Barstad, Eco Services, Meto	Pat Lynch, Waters, Metro
	Jeff Gorton, Fisheries, Metro	Judy Mader, MPCA
	Gretchen Benjamin, WDNR	Gary Wege, USFWS, Bloomington

Responses to Minnesota DNR Comments dated April 5, 2001

The major cause of the sedimentation in the Diamond Island channel has been a shift in the outlet of the Cannon River. The solution would require construction of a closure structure across the head of the channel to redirect Cannon River flows behind the island. Bank stabilization along private property could also be required. Construction of the closure structure would require use of an authority other than our navigation project authority (such as EMP or Section 1135), as the closure structure would provide no channel maintenance benefits and there is no Federal land involved. If the closure structure is pursued under another authority, the District channel maintenance program could consider participating by notching the closing dam. The wing dam would probably not have to be modified.